

OCTOBER 1980

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# Popular Mechanics

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tires ■ Snow escape  
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... and more!

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THE YANKEE WAY**

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PLANS**

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  - Build PM's oversize sawbuck
- PLUS:**

**Complete guide to crosscut saws**



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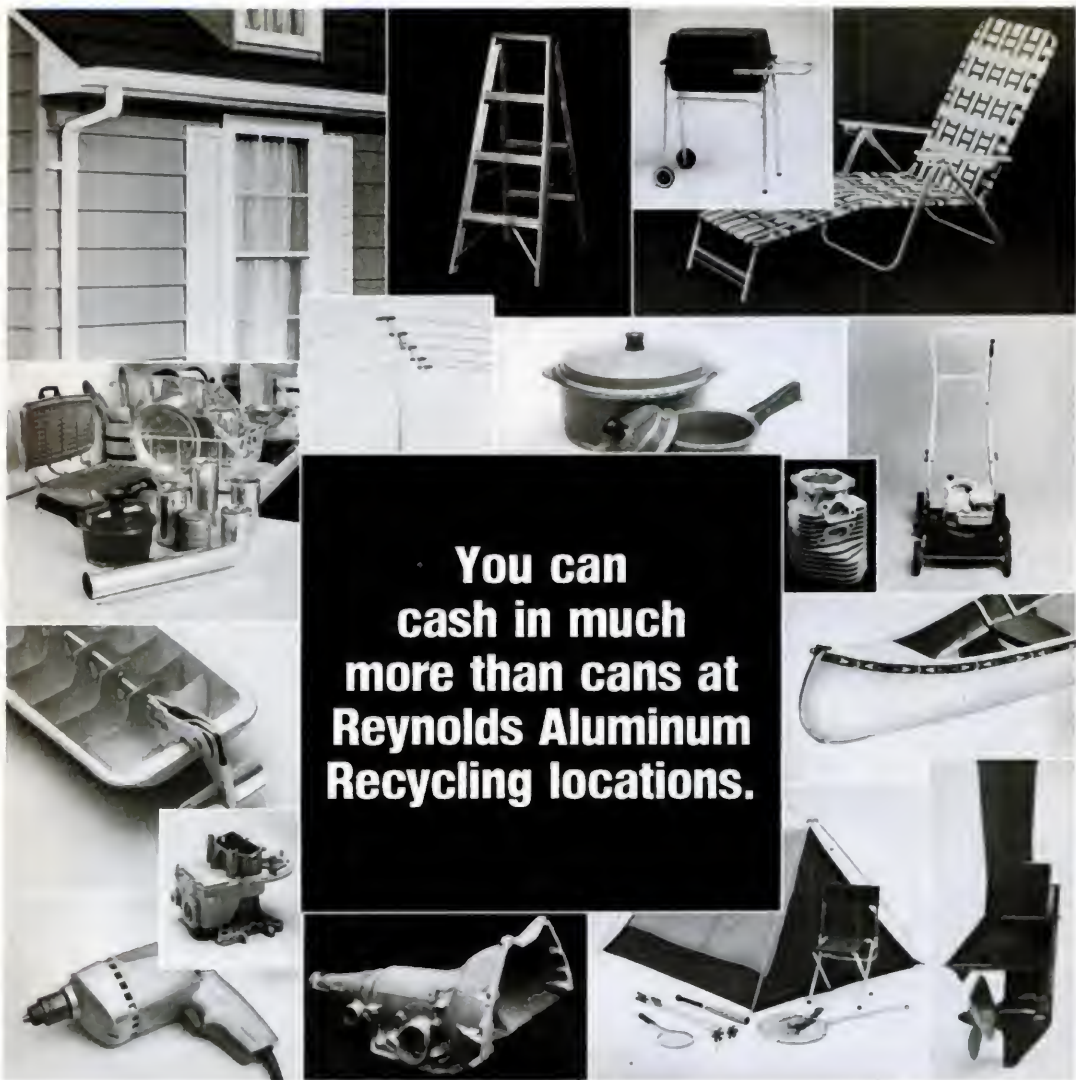
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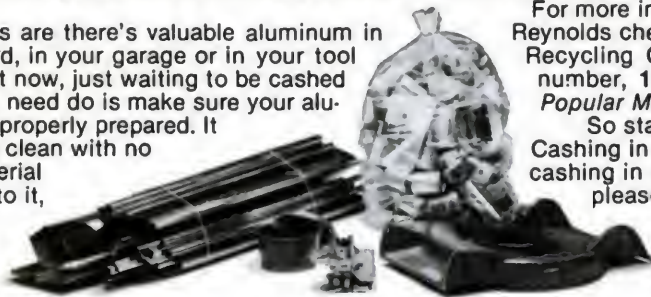
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Reynolds has over 1,000 recycling locations, coast to coast. And last year alone we paid our recyclers over \$45,000,000 for their used aluminum. So it really can be worth your while.

For more information on recycling with Reynolds check your yellow pages under Recycling Centers, or call this toll free number, 1-800-228-2525 and mention *Popular Mechanics*.

So start getting it together today. Cashing in old aluminum is as easy as cashing in cans and clearing it out will please everybody.



**Reynolds  
Aluminum  
Recycling Pays®**

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## SUPER BOWL WARMUP! GET YOUR NFL THERMOS JUG 'N' MUGS.

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Super Doers of America. Doing it themselves. Doing it right. Get your tagged Stanley tools at super prices from participating dealers.

### STANLEY

helps you do things right.™







## On the cover

The American way of energy consciousness is taking over, with self-sufficiency being the aim in supplying the country's traditional fuel supplement—wood. Traditional tools, like PM's saw and sawbuck, can still do the job efficiently.

—PM photo by George Ancona

# Popular Mechanics®

OCTOBER 1980

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# I've earned my Wings!



## Red Wings

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SHOES

"When I was just learning my job, the guys who'd been around wore Red Wings. Now I know why. It's the tough, full-grain leather—and the way they're made. They really stand up! Best of all, they make my feet feel good—from the time I put 'em on to the end of the day. My feet deserve that comfort—'cause I've earned my Wings!"

*Red Wings: Plain or safety steel toe, 100 styles, sizes 6-16, widths AAA-EEEE\* to fit your job and your feet. Look in the Yellow Pages under "Shoes."*

**For feet that have earned the best.**

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## Volkswagen's new Pickup: It's built like a truck, but drives like something else.

Where is it written that a truck has to drive like a truck? Certainly not on that brand new Volkswagen Pickup Truck. When it comes to going, a VW Pickup can pick 'em up and lay 'em down with the best of 'em. Under its aerodynamic hood is a very dynamic engine. A fuel-injected, overhead cam powerhouse that can outaccelerate even an MGB.

And should you ever catch up to a VW Pickup, you'll never catch it wallowing through corners like other trucks. Its front-wheel drive and front-mounted transverse engine help keep it moving nimbly. Even when the road throws it a curve. The steering is precise and quick because it's Volkswagen's rack-and-pinion system. What's equally impressive is how good a pickup a VW Pickup is. It's the only truck in its class with a fully unitized body and double-wall

bed construction for extra strength. And its heavy-duty suspension takes the tension out of hauling over 1100 pounds of stuff. So a truck is a truck is a truck, eh? Well, not if it's a Volkswagen Pickup Truck. Then it's something else.



This One



2UF4-NRP-KZ9D

# LETTERS TO THE EDITOR

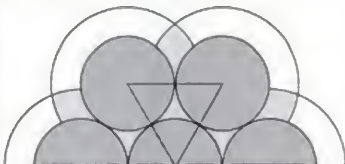
## Got the time?

I read with great interest the polar-sundial project (*Four Great Back-Yard Projects*, page 130, May '80). Here's a third method for marking off the hours on the dial that I think will be much simpler for many readers.

If you have a calculator with a "tan" key, you can make a table of distances along the sundial with the formula  $d = h \times \tan(15 \times H)$ , where  $d$  is the distance from the noon mark,  $h$  is the gnomon height (in your example, 3 inches) and  $H$  is the hour.

ROGER L. MANSFIELD  
ASTRONOMICAL DATA SERVICE  
COLORADO SPRINGS, COLO.

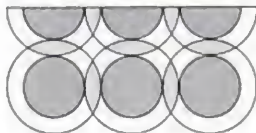
In the project on installing a lawn sprinkler system (page 131), you indicate an overlap of sprinkler coverage of two or three feet. This does not provide even coverage. We recommend an overlap of at least 60 percent. Tests show that only 60 per-



PROPER SPRINKLER SPACING  
(12'-RADIUS SPRAY SPACED 15')

DARK AREAS REPRESENT 60% OF RADIUS, AMPLE WATER.  
LIGHT AREAS REPRESENT DOUBLE COVERAGE, AMPLE WATER.  
WHITE AREAS INDICATE INSUFFICIENT WATER.

IMPROPER SPACING  
(7-1/2'-RADIUS SPRAY SPACED 12')



Sprinkler heads must provide an overlap.

cent of the diameter of a spray head emits enough for ample turf growth.

You also state that a check valve is all that is necessary to prevent contamination of potable water. This is not always the case. Some codes require the irrigation installer to place a pressure-type vacuum breaker in the line. Others require an antisiphon breaker. Some don't specify any type of protection against contamination.

We recommend a pressure-type breaker before the placement of the first irrigation valve.

THOMAS J. SCHILTZ  
DIRECTOR OF EDUCATION  
AND TECHNICAL SERVICES  
THE IRRIGATION ASSN.  
SILVER SPRING, MD.

## Font of knowledge

The potential for the multiplication of styles of printing type may be exciting ("Computerizing Gutenberg," *PM Electronics Monitor*, page 8, June '80), but to me it is somewhat disturbing.

We are on the threshold of a new

## When you're ready to groom a room.

Beef up your bath. Shine up your sink. From faucet fixtures to tile tools, at Sentry Hardware, our friendly experts have the right advice to help you do it all. And the right prices, too.

- A** **Kwikset**® Bathroom or Bedroom Privacy Lockset (#300BUS3)
- B** **STANLEY**® 3/4 inch x 16 foot POWERLOCK® Tape Measure (#PL316RM)
- C** **Rockwell**® 3/8 inch Variable Speed Reversing Drill (#4150)
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- F** **Merco**® Carriage House Gift Set (#C9000SS)
- G** **Weller**® Soldering Gun with Accessories (#9200K)



**F** \$26.99

**E** \$2.77

**A** \$5.99

**B** \$6.99

**C** \$29.99

**D** \$29.88

**G** \$14.88



## When you're ready to do-it-yourself.

Check the Yellow Pages under Hardware for the SENTRY store nearest you. Interested in becoming a Sentry Hardware dealer? Contact us at Sentry Hardware Corporation, Cleveland, Ohio 44113.

Merchandise shown in this advertisement is available from participating Sentry dealers only. Offer expires November 1, 1980. The 4,500 Sentry dealers own their stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.





# LEADERS HAVE TASTE

Even the look of the A&C Grenadier rewards the choosy smoker. It's long and lean. Touch a match to it, and here comes rich, exciting aroma, full and satisfying taste. At its heart, a richly rewarding blend of five fine imported and domestic tobaccos. All of this sealed in our Fresh Loc package. When you've got the taste for leadership, light up an A&C Grenadier. In light or dark natural wrapper.



## A&C GRENADIERS—THE TASTE LEADER

age—an age in which the blind and other print-handicapped people will be able to read regular print with the aid of a machine. The machine is a computer that can read in totally synthesized speech to blind people. The rules for optical character recognition, English text-to-speech conversion and proper voice inflection already consume over one million bits of memory. Since every new type style and font must be programmed into the computer for it to be able to identify each letter, any multiplication of type fonts means that the machine's ability to read all available printed material is hindered.

Before plunging headlong into the production of any new fonts, we should ask: Are they really necessary, or will they make it more difficult for print-handicapped people to gain immediate access to printed materials?

STEVE POLLO  
HANDICAPPER SERVICES PROGRAM  
MICHIGAN STATE UNIVERSITY  
EAST LANSING, MICH.

### Screened out

The projection TV stories in the Feb. '80 issue (*Get the Big Picture: Pick of*

*the Projection TVs*, page 104, and *Build a Giant-Screen TV—From Kit or Scratch*, page 107) were well presented and very informative. However, the thing that interests me most was only briefly covered. I could find no detailed information on how the screens are manufactured.

I am very interested in building reflective screens and would appreciate it if you could tell me where to buy the material for the front of the screen.

ELIO CHIAVETTA  
LATINA, ITALY

*Unfortunately, the highly reflective material used when building such projection TV screens is not available to do-it-yourselfers; your best solution to the problem is to buy a factory-made unit.*

### Don't touch that dial

As a TV repairman, I could not believe you suggested that people clean their own tuners ("Cleaning your television tuner," *PM Electronics Monitor*, page 13, Aug. '80). If a beginner were to do as pictured, chances are he would only be spraying cleaner on the fine-tuning shaft

and not hitting the contacts at all. I've had sets coming into the shop from people following similar advice. Wires were hanging and parts were broken inside. You're going to have a lot of unhappy readers when they receive a repair bill for damages from simply cleaning their television tuner.

The directions you printed may seem clear to you and a few people, but there are always those who cannot follow directions.

ALBERT A. CLOUTIER  
PORTSMOUTH, N.H.

*The simple act of spraying cleaner into a tuner cannot harm a TV; broken parts and hanging wires are the product of faulty disassembly or mishandling.*

Besides, the readers of *PM* are well known for their ability to follow directions. If they follow ours, they'll have cleaner TV tuners.

### Correction

The correct address for the magnetizer that appeared in the Aug. '80 *PM Workbench* (page 53) is Jay-Gee Manufacturing Co., 4191 Southwest 11th Terrace, Fort Lauderdale, Fla. 33315.

PM

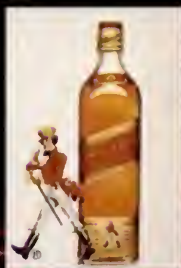
100% BLENDED SCOTCH WHISKIES. 86 & 8 PROOF. IMPORTED BY BOMERSET IMPORTERS, LTD., NEW YORK, N.Y.



THIS WEEKEND, SIT DOWN  
AND TAKE TIME OUT FOR RED.

JOHNNIE WALKER® RED

THE RIGHT SCOTCH WHEN ALL IS SAID AND DONE





# ALL OUTDOORS

## Shooting safely

Firearms are far down on any list as the causes of accidents—getting out of a bathtub, riding a bike or walking around your home are much more dangerous. Any accident, however, is one too many, and hunting season is a good time to look at causes and cures. Air rifles are one of the best ways to learn safe gun handling, and recently Jack Powers of Daisy, long a leader in safety training, made an analysis of hunting casualties.

For the Virginia Wildlife magazine, state game wardens filled out questionnaires giving details on 972 hunting fatalities occurring from 1961 to 1977. This is only 14 accidents per 100,000 licenses sold over a 16-year period, but the results indicate that almost all of these were preventable.

A total of 194 victims were mistaken for game animals or birds by shooters, while 136 were out of sight and were killed by bullets traveling beyond the animal shot at. There were 99 casualties because moving game passed between the shooter and the victim, and the same number, 99, were shooters who stumbled and fell, discharging guns that injured themselves or companions. In 61 cases, the trigger caught on an object and discharged the firearm, while 61 more accidents occurred removing or replacing loaded firearms in vehicles. Victims moving into the line of fire totaled 46. In 29 instances, loaded firearms fell from unstable rests, while 27 discharged while the shooter was crossing an obstacle like a fence.

Most inexcusable of all, 21 happened during horseplay with loaded guns. Eleven were the result of clubbing game with a firearm. There were also 29 mechanical failures that caused casualties. While some of these probably could not have been prevented, it is well to remember the importance of careful maintenance and the fact that no "safety" should be considered completely safe and an excuse for carelessness. Ten percent of the accident causes could not be determined.

In almost every case, the ways to prevent each of these accidents are stressed in hunter training programs. It would appear that such training should be required for each license purchaser and reviewed each time an owner uses his firearm.

## Piggyback pack

Outdoor sports are more fun as family affairs, and when Dick Maher's son Steven couldn't hike along because of muscular dystrophy, Dick checked with the clothing and field equipment designers at the Army Research and Development Com-



Dick Maher and son Steven, of Weymouth, Mass., show hiking for handicapped.



Developed by Army R & D Command, new NAP Pack is nylon mesh vest and seat.

mand at Natick, Mass., near their home in Weymouth. The result is a nylon mesh vest with rear seat and straps that acts as a backpack to carry Steven. The Army sees possible applications for it in carrying casualties. It's been named a "Non-Ambulatory Personnel Pack," or NAP Pack. Unfortunately, it isn't yet available commercially, but meanwhile clever do-it-yourselfers might work up a similar one.

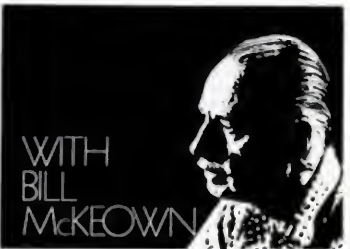
## Season stretchers

New gear that can do double duty in warm and cold weather has been announced recently. For planners who carefully stow their camping supplies in preparation for storm emergencies or power outages, there's now canned milk that is reported to have shelf life of over one year. It's not evaporated, condensed, dehydrated or doped up with preservatives, and, best of all, it tastes right. Called Kan-Pak Whole Milk, it's just sterilized and vacuum-packed and comes in large three-pound cans in regular (\$2.10) and chocolate milk (\$2.25). It's available from Stow-A-Way Industries, 166 Cushing Highway, Cohasset, Mass. 02025. They also carry a wide variety of freeze-dried foods for all emergencies.

Frostline Kits, at Frostline Circle, Denver, Colo. 80241, has added a nylon Cordura Log Carrier Kit for \$12, and a \$59 Mountain Parka Kit you sew up using the new low-bulk Thinsulate insulation lining.

For compact camping, Coleman has even come out with a mini-model of its famous lantern. It is brown, half the size of the standard green mantle lights, is part of the Peak 1 line and in backpacking stores.

For selections of fall clothing, camping and fishing equipment, guns, boats, van accessories and even skis and snowshoes, J.C. Penney has a new fall and winter Outdoors Catalog from Box 1270, Milwaukee, Wis. 53201, or in stores. **PH**



The background of the advertisement is a complex, stylized pattern of blue and black lines that resemble a circuit board or a digital signal path. The lines are arranged in a grid-like fashion, with some lines curving and branching out. In the center of the image, there is a small, rectangular yellow chip with black markings, which appears to be a microprocessor or a similar electronic component. The chip is positioned slightly to the left of the main text area.

Announcing a  
remarkable new system  
for 1981 GM cars.

# COMPUTER COMMAND CONTROL



From now on  
you'll activate  
a computer  
when you step  
on the gas.

For 1981, all standard and most optional gasoline engines\* from Chevrolet, Pontiac, Oldsmobile, Buick and Cadillac will have GM's new Computer Command Control system.

It allows GM to achieve the *highest* Corporate Average Fuel Economy (CAFE) in GM history, while also reducing automobile exhaust emissions to the *lowest* in GM history. CAFE, as you probably know, is the federal government's measure of a car company's overall annual fuel economy.

### Brain Power Plus.

In its simplest form, a solid-state electronic control module (ECM) monitors oxygen in the exhaust, engine speed and engine coolant temperature through three highly specialized sensors.

\* GM-built engines are produced by various divisions. Ask your dealer for details.



### It can talk to you, too.

Even the most reliable of systems can sometimes require service. So just in case, Computer Command Control is programmed to tell

you if something needs attention.

First, an indicator light on the instrument panel tells you to "check engine." But that's not all. One of the most dramatic features of the system is its ability to send a coded message to your service technician indicating which circuit in the system to check.

### Important benefits.

In this day of greater concern for the world we live in, plus the reality of our dwindling natural resources, we think Computer Command Control offers solid proof of our ongoing commitment to design and build cars for a changing world.

Quite simply, the system helps us clean the air while giving good fuel economy.

### Digital Dexterity.

Analyzing this information at thousands of calculations per second, it then adjusts the air/fuel mixture in the carburetor (or fuel-injection system in some models) to optimize combustion. The exhaust gases then pass through GM's new dual-bed catalytic converter to be cleaned up before entering the atmosphere—mostly as water vapor and harmless CO<sub>2</sub>.

### Space Age Reliability.

Computer Command Control is built by our Delco Electronics Division, the same people who build inertial guidance navigation systems for many of today's jetliners. And it has been tested over millions of miles of both on-highway and test-track evaluation. In fact, Computer Command Control, together with the rest of the emissions control system, is covered by a 5-year/50,000-mile warranty. Ask your GM dealer for details.



*Designing and engineering cars for a changing world.*

Chevrolet • Pontiac  
Oldsmobile • Buick  
• Cadillac



# DETROIT LISTENING POST

## GM's experimental commuter

General Motors is working on a number of experimental commuter cars. The spy photo (below) was snapped in June near the GM Design Staff headquarters and shows what we believe to be a two-passenger hybrid commuter vehicle.

Wheelbase is estimated to be around 80 inches. The body seems to be fiberglass, and a small engine—perhaps an opposed twin—rests ahead of the front-axle centerline,



GM experimental hybrid will be a micro-car powered by batteries and a tiny gas engine.

driving either the front wheels or a generator or both.

Judging from the relatively large amount of front overhang, there could be space for six or eight lead-acid batteries under the hood.

GM has said that it will release a little commuter electric of this general configuration for 1985. We'll see if this is the one.

## Revised GM plans

While everyone else is frantically cutting his spending wherever possible, agonizing over which programs must go and which can stay, rich old GM is revising its future-product investment projections upward to get new machinery into the showrooms as quickly as possible. Previously pegged at \$38 billion between now and 1985, GM's capital spending ante has been raised to \$40 billion over the same period. Putting that into perspective, it amounts to spending \$22 million every day, 365 days a year, for the next five years!

First off, the debut of the '82 Olds, Buick and Cadillac versions of the small, front-wheel-drive J-cars has been accelerated by half a year to next fall as '82 models. Chevy and Pontiac Js will be unveiled in May 1981. Already the biggest new-model year ever for the corporation, '82 will also bring all-new front-wheel drive intermediate A-cars (two-doors only), downsized Camaro/Firebird F-cars, restyled Seville/Eldo-

rado/Riviera/Toronado K-cars and E-cars and domestic-built Chevrolet mini-trucks.

For the '83 model year (just two years from now), the new and downsized (again) fwd B and C large cars are still on the schedule, plus the smaller Corvette and the sporty, fiberglass-bodied, mid-engine Pontiac and Chevy two-seaters. And for '84 (all a year ahead of the original plan) comes a new fwd S-car (a size smaller than Chevette, which stays around until '86) and all-new fwd K- and E-cars (with transverse V6 engines). And some all-new fwd personal coupes to replace the Monte Carlo/Grand Prix/Supreme/Regal may also make their appearance.

## Would you believe 85 mpg?

GM says by 1985 its new-car fleet will average better than 31 mpg, with 75 percent of its vehicles getting above that figure. That's nearly 6 mpg better than the corporate average fuel economy (CAFE) requirement for that year set by the National Highway Traffic Safety Administration (NHTSA). It shows once again that market demand and competitive pressure have far greater influence on technology than any artificial outside force. Now that demand for fuel-efficient small cars is way ahead of supply, the industry is knocking itself out to close the gap. Now that the industry has awakened from its long slumber, legislating greater fuel economy would probably be a waste of time and money.

But NHTSA's Joan Claybrook is talking 40 mpg by 1990, and one Washington study group has called for a CAFE requirement of 85 mpg by 1995—better than even the smallest motorcycles can deliver today! That seems to call for tiny single-seaters powered by lawnmower engines. If 85 mpg becomes feasible for anything resembling an automobile by then, and if the public demands it, it'll surely happen. But you don't change the laws of physics by legislation.

## Ford V6 coming

Ford is firming up plans to build its own V6 engine in a new plant near Windsor, Ont. Displacing 3.6 liters, it will be designed for transverse fwd applications in compact and larger cars by the '83 model year. First application should be as an option in

the coming fwd replacements for Fairmont/Zephyr compacts. This engine will likely be installed in Ford's largest cars by 1984 when they're revamped to fwd. By then the mighty V8 will have totally disappeared from the passenger-car scene and will be found only in trucks.

## Chrysler revises schedules

In an effort to reduce their company's fixed costs and regroup forces, Chrysler Chairman Lee Iacocca and Engineering Vice President Harold Sperlich have announced that by the fall of 1981, Chrysler will no longer build the LeBaron or Diplomat. Instead, that hole in the model lineup will be filled by stretched versions of the newly introduced fwd K-cars. These will carry virtually identical running gear as the K-cars, but will offer a higher level of trim and a more plush option package. Iacocca goes on to say that by 1982, Chrysler will be "selling nothing but front-wheel-drive cars."

This leads us to wonder what will happen to the newly introduced Imperial. It will either have a very short life span, indeed, or the same may simply be transferred to a car built on the stretched K-car platform.

As to what kind of engines will power the enlarged K-cars, Sperlich completely rules out the possibility of a Chrysler-built V6. "We see the U.S. car fleet developing along the lines of that in Europe," Sperlich says. "In Europe, V6s are taking a drubbing. European V6s and cars that go with them are market casualties, just as V8s are here. We may purchase V6 engines, but we won't make them." Instead, Chrysler is working to further develop its brand-new 2.2-liter Four. Other possibilities include four- and six-cylinder diesels.

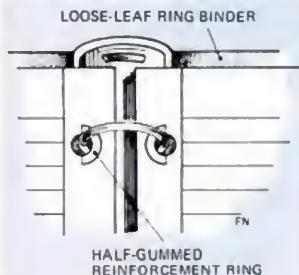


BY  
GARY  
WITZENBURG



# HINTS FROM READERS

## Gummed savings



To stretch your supply of gummed reinforcement rings, use only half a circle to mend torn notebook-paper holes. This trick also saves you the trouble of opening the binder ring to make the repairs.—*Lou Sculica and Harry F. Dill*

## Keeping trash bagged

To reinforce a plastic garbage bag so that it will support a weighty load, I first position a flattened cereal box in its bottom.—*Helen LeMunyon*

## Special-purpose brush



Cut your old brush bristles to desired length and insert them in the tubing.



Peen the tubing to hold bristles in place.

In a pinch, you can fashion a long-handled, gasket adhesive brush from scrap.—*G. Williams*



## "I HAVE NO IDEA WHAT EVERYONE ELSE IS DRINKING THESE DAYS"

Sure, in school I drank beer. Because everyone else drank beer. Crushing the cans was real important, too. And then there was what I call my "wine phase." You know, wine with everything. And everyone.

The funny thing is, there are still people out there who order what everyone else orders. That's fine with me...but I'll have an I.W. Harper. Because the only "smart" thing to order is what you like.

So, like I said, I have no idea what everyone's drinking these days. Except me and a few friends.



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for you to learn BASIC high level language programming and assembly language programming.

It's also important to note that our microcomputers are not home-made training devices. They are production model micro-systems, identical to many you'll encounter in the field. We believe this makes your training a lot more exciting and relevant.



NTS's Master Course in Microcomputers includes the NTS/HEATH H-89 Microcomputer (#1 above). It features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory expandable to 48K. HDOS included.

The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer with 1K of RAM memory, expandable.





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NTS has many different electronics programs to choose from. One of our most popular is Color TV Servicing—and it's no wonder. You build and keep an NTS/HEATH 25 inch (diagonal) digital color TV as part of your training. Choose Communications and you'll train on an NTS/HEATH 2-meter FM transceiver that you'll also build and keep.

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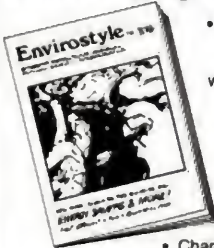
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## NOTES FROM THE EDITOR

*John A. Linkletter*

**E**ach summer, PM and other magazine publishers get ourselves charged up with youth and enthusiasm by taking magazine interns onto our staffs. The interns come from colleges all over the country and spend some 10 weeks working as regular staff members. PM had three: Ben Dunlap Jr. of Terre Hill, Pa., who is now back at West Virginia University as a senior journalism major; Tony Pace of Summit, N.J., now in his second year of the two-year MBA program at Wharton Graduate School, University of Pennsylvania; and Glenn Butash of Weston, Conn., now a sophomore at Boston University. At the end of the summer, all three agreed they liked magazine publishing and would consider it for a career. We're ready!



Standing: Ben Dunlap Jr., Editor John Linkletter, Tony Pace and Glenn Butash. Seated: PM Publisher Joseph Kern.

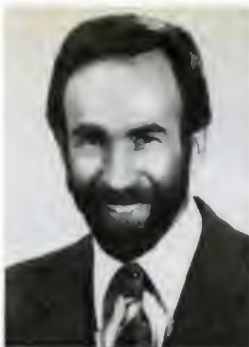
The Inscrutable Orient became somewhat more so for us recently when auto editors Tony Assenza and Gary Witzenburg were in Japan researching this month's Mazda stories (pages 83 and 101). In past years, PM auto writers have traveled to almost every place in the world where cars are manufactured, and they created only a modest bit of fuss. But for some reason that still eludes us, a crowd of Japanese school kids suddenly decided that Witzenburg-san was a famous personality—maybe a movie star—and they besieged him for autographs. Since there is not yet a Japanese edition of PM, it's unlikely they've seen his byline, so we haven't figured out yet who they thought he was. . . . I was fortunate enough to be in Hiroshima two and a half years ago for the introduction of the Mazda sports car, the RX-7. It didn't take any great prescience to see that the manufacturer, Toyo Kogyo, had come up with a winner. That nifty little car has scored well with American drivers, as you'll see in the Owners Report (page 86). It was also apparent why Kenishi Yamamoto, the man most responsible for developing the Mazda rotary engine, succeeded where others failed. When asked why much larger companies had not been able to build a rotary that would really work, he replied simply: "They didn't have the passion." He had it and it worked.



Gary Witzenburg and some fans.

PM





"I made it despite myself."

# Success Forces

Can you be successful despite yourself? Here's how I did it.

By Joseph Sugarman, President  
JS&A Group, Inc.

It's a joke. I'm considered one of America's top copywriters and mail order entrepreneurs.

I never finished college, never took a course in business, advertising or creative writing, and even flunked English.

On top of that, I failed at almost everything I did. My list of failures would fill an encyclopedia.

Now you probably expect me to tell you that it was failure after failure until I hit upon the "wealth formula" or the "secret to success" or some other trite expression. Not true.

## ONLY SIX REASONS

What I've found about success is quite opposite the formulas you've read about or the misconceptions you've heard.

I simply took my few successes and many failures and discovered six reasons why I failed and six reasons why I succeeded.

The reasons I succeeded seemed like forces. Whenever I followed them, I achieved success. Whenever I didn't follow them, I failed. I soon called them Success Forces.

I used Success Forces to build my business from the basement of my home into America's largest single source of space-age products. I was successful. But was it a coincidence or was it a direct result of Success Forces? I really didn't know.

## MATERIAL THINGS

If you measure success by material things, I achieved quite a bit: several cars, airplanes, snowmobiles, motorcycles, four beautiful homes—all the material things I imagined I'd ever want.

And I had recognition. My success story was written up in several magazines. But it wasn't until after I revealed my Success Forces in a few speeches that I realized my concept would work for others.

I was getting letters from people who told me how one of my Success Forces had changed their lives. Others told me of how they used Success Forces to make extra money or achieve greater happiness. Still others who always thought of themselves as failures, became successful despite themselves.

But the whole thing seemed strange to me. Was Success Forces original? Something like it had to be in some other success book. So I read. I bought every success book I could find. I studied Chinese philosophy. I bought every motivational cassette that was offered. And I thoroughly studied the material.

I then discovered why my concept was indeed different. Success Forces lets you be yourself, and guides you towards making simple choices that can ultimately change your life. If you make the right choices, you are literally forced into success.

## MY \$2,000 SEMINAR

Although I was convinced that my concept was different, I wanted to be absolutely sure it would work. I decided to conduct a seminar with a select group of 16 people who would be willing to pay handsomely to learn my philosophies. My five-day seminar cost each participant \$2,000 and I held eight of them. All were sold out.

The success stories resulting from each seminar are already history. I taught a Texas farmer, a New Zealand rug merchant, a lady from Australia. There were people from all walks of American life, many of whom paid their last \$2,000 to attend.

Not all of the participants succeeded. But so many did become successful and so many told me later how I literally changed their lives, that I was convinced Success Forces should be available for everybody to use.

## NOW AVAILABLE

I am now making my concept available in a hardbound book entitled "Success Forces." It contains examples from my speeches and the philosophies from my seminar that participants paid \$2,000 to hear.

A few of the Success Forces you may already know and have been subconsciously following for years. Others, you may have been fighting, thinking that you would fail when all along you would have succeeded. A few of my Success Forces require action—the type of action that everybody can take and that requires no special skill.

This is not a step-by-step book on how to get into a business that promises "A Lazy Way to Riches," or a way to "Quit Your Present Job." It does not matter if you are in business nor whether you want to work hard, take it easy, or just plain be successful.

## TEACH HIM TO FISH

There's a saying: "You can feed a man a fish and he'll eat for a day. But teach a man to fish and he'll eat for a lifetime." My book will help you for a lifetime.

I'm not somebody who writes a book on how to make a fortune and then makes my fortune from the sale of the book. I've already made it. Nor am I going to send you a cheaply printed thin paperback. That's not my style. My book is a 200 page hardcover volume that I guarantee you will both enjoy and benefit from. In fact, I will go one step further. After you read it, wait one year. If you have not noticeably benefited from reading Success Forces, return your book to me and I will refund your money in full. Success Forces must give your life additional meaning within one year or your money back. It's that simple. This one-year return offer applies only to those individuals purchasing my book via mail order.

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The antman (above) is from Automated Simulation's *Temple of Apshai* program, which features some hilarious animations.

These dragon-slaying programs understand English commands. Versions now on home computers will soon show up on video games, too.

by Neil Shapiro  
ELECTRONICS EDITOR

**T**here's an adventure in your future—on the high seas, deep within mysterious and dark caves, in a brawling medieval tavern—all thanks to the most versatile of modern appliances, the home computer. These new adventure games simulate the excitement of a quest.

There's no doubt at all that versions of these games will very soon show up on cartridges for home video games. So, if you have a home computer now, consider this a look at what's available. Otherwise, here



Synergistic's *Wilderness Campaign* displays map of the territory as a playing area.

# New computer adventure games



is a preview of what will be happening soon in video games.

It began a few years ago when computers were all the realm of professional programmers and only large companies and colleges could afford the machines. It was at Princeton that the first adventure game was programmed.

That game survives to this day in new versions we saw from Microsoft, Programma and Rainbow. Each company's version differs a little bit, but they are all descendants of that Princeton granddaddy. In the computer's memory is a programmed visualization of a complex—and dangerous—series of interconnected caves. Each cave contains devices and objects that may help or hinder the imaginative traveler (everything from axes to diamonds).

Besides having to battle the inhabitants (killer dwarfs, pirates and other undesirables) an adventurer must solve puzzles. If he comes up against a locked, iron door, then in order to continue deeper into the cave, he must find a hidden key. Other puzzles may be complex enough to require an hour to solve.

One of the interesting features of some of these programs is their abil-

ity to "speak" English. If a readout reports that you are in a room containing an ax, then you only need to type in the words "take ax" to arm yourself. You can then "throw ax" or "drop ax" or do a number of axlike things with it. But if you should type in something akin to "eat ax," the computer would respond by saying "I can't do that."

The secret is called a *parser* program. This program examines verbs and sees if the objects match. It is one of the most sophisticated of programming techniques.

The same technique is used in programs such as *World of Odyssey*, from Powersoft, and *Journey*, from Softape. Their "maps," however, are different from the original Adventure caves. *Journey* features some entertaining twists and traps and is written in a tongue-in-cheek style. *Odyssey* is another complete, complex, computerized cavern.

We also looked at two programs from Programma International, called *Earthquest* and *Castle Adventure*, that add a further dimension to the concept of a *parser* program. These not only accept English words as input, but make up their own

(Please turn to page 24)



# Miracle Fuzz

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That small piece of fuzz located on top of the cylinder shown above emits negatively-charged electrons which attach themselves to molecules of oxygen, thus creating ionized oxygen.

You are already familiar with ionized oxygen if you've smelled the air after a thunderstorm. You feel great, revitalized, and alert. The lightning from the storm adds a small negatively-charged electron to each oxygen molecule in a process called ionization.

## SCIENTISTS DISCOVER

Scientists discovered that air quality can actually affect your moods, your feelings and your sense of well being. Air that is positively charged caused people to be depressed, moody and tired. Negatively-charged air made people feel good. We have all experienced air that is positively charged in air-conditioned buildings or in a polluted environment.

Scientists looking for a way to turn positively charged air into negatively charged air developed the negative ion generator—a product that produces negatively charged particles that attach themselves to air molecules and thus create the same fresh feeling you get after a thunderstorm.

The new space-age product shown above is an ionized oxygen generator called the Energaire air purifier. The copper mesh fuzz on top of the unit is one of the secrets of the system.

Although it has no moving parts, you can actually feel a wind of ionized oxygen produced from the fuzz which spreads to fill an average-sized room in one minute.

## CIGARETTE SMOKE TEST

To show the dramatic effect of ionized oxygen, you can take the Energaire, blow cigarette smoke into a clear bowl, and hold the bowl inverted over the system. The smoke will vanish. The charged oxygen particles appear to dissolve the smoke particles, precipitating them from the air.

In a room, the Energaire air purifier surrounds you with these oxygen ions and cleans and purifies the air so that even in a smoke-filled room, you will be breathing cleaner, country-fresh air all day long.

## WALL TEST

Take our unit and place it next to a wall. Also

put a large piece of paper on the wall. Within a few days notice how black the paper gets. That black film is finite carbon particulate matter—the same pollutants you would normally breathe and that would pass through most air filters. By placing the unit in the center of a room or away from a wall, that same matter falls to the ground as dust.

A trip into the mountains exposes you to nature's freshly ionized oxygen. The Energaire produces this same effect. It will clean your room of odor-causing bacteria and stale, musty, or smoky air.

Ionized oxygen should not be confused with ozone. Ozone has a molecular formula of  $O_3$ , whereas the molecular formula for ionized oxygen is  $O_2$  with a negatively-charged ion.

## DON'T BE CONFUSED

After we announced the Energaire last year, many companies came out with their own ion generators. We purchased a unit from each company and tested them at an independent laboratory. The results are shown below:

Name	*Ions	Price
Energaire	438,000	49.95
Omega 700	63,000	245.00
AirCare	72,000	149.95
Modulion	75,000	79.95

\*Measurements indicate total number of ions per cubic centimeter per second at one meter. These figures may vary by plus or minus 10%.

Note: One unit not mentioned above produced no ions and actually produced ozone or several times the maximum ozone concentration allowed by federal government standards.

## USED IN HOSPITALS

Many hospitals are now using ionized oxygen systems in their operating rooms and burn centers. Their units not only purify the air, but they also eliminate pollen and other irritants.

Working in a clean air environment, you think clearer, are more alert, and you function better. The Energaire is actually a miniature lightning machine. The minute you plug it in, energy is converted into ionized oxygen. This efficient system uses one watt of power or less than a penny per day to operate, so you leave it plugged in continuously.

We are so impressed with the pleasant effect of Energaire that we urge you to personally test it yourself in your home or office. Order one at no obligation. Put it by your desk, or in any room where you spend a great deal of time. See if it doesn't rid your room of odor-causing bacteria and stale, musty or smoky air. Try the smoke and paper tests mentioned in this advertisement.

## SLEEP FASTER

At home, use the Energaire by your bed and see how country-fresh air allows you to sleep easier, deeper, and more relaxed.

You should notice the difference within one day—especially in a work environment. But use the Energaire for a full month. Then, if you do not feel totally convinced of the positive effects of ionized oxygen, return your unit for a prompt and courteous refund.

The Energaire is manufactured by the Ion Foundation, a leading ion research and development company.

Service should never be required, but if it is, there's a prompt service-by-mail center as close as your mailbox. JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected. The Energaire measures 9" high by 3" in diameter and weighs 24 ounces.

To order your Energaire ionized oxygen generator, send \$49.95 plus \$3.00 for postage and handling (Illinois residents, please add 6% sales tax) to the address shown below or credit card buyers may call our toll-free number below. We will send your Energaire ion generator complete with 90-day limited warranty on the electronics, a five-year warranty on the fuzz, and complete instructions.

Let space-age technology revitalize your life with the world's first home ionized oxygen generator. Order one at no obligation today.

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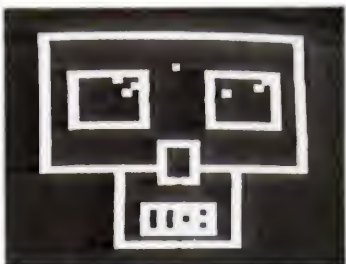
## COMPUTER ADVENTURE GAMES

(Continued from page 22)

names for people and places as output. Because the programs pick vowels and consonants in about the same frequency of distribution as is found in English, the nonsense words seem more like a foreign language than anything random.

*Earthquest* takes full advantage of this English-sounding word generator. The program is an interplanetary trip in search of the lost planet Earth; it has new names for out-of-this-world places.

Then, there is a fellow called Scott Adams and his software company



*Fracas*, from Quality Software, allows multiplayer options among graphic mazes.

Adventure International. His series of eight adventures, available for all personal computers, are truly amazing and a good sample of what future programs will probably be like. A Scott Adams adventure is much like a challenging Chinese puzzle.

In the Adams adventure *Mystery Fun House*, it takes a certain amount of ingenuity just to begin the game. The computer tells you a ticket is needed to enter the funhouse. You hunt around and find a parking lot to the East. There is a locked grating on the ground. You look through the grating. There is a dollar bill below. To get the dollar, you must use a number of other items lying around. Adams has invented an entire programming language for his adventure games.

*Space*, a most enjoyable game from Edu-Ware Services, simulates an entire lifetime in the world of tomorrow, from serving you a draft notice for the Space Marines to trading on an intergalactic Big Board. Characters age, accumulate wealth and often meet untimely ends.

Up to this point, the games we have talked about just put words onto the screen. There are also adventure games on the market that use the computer monitor (television) for pictorial display. Though the present ones do not communicate via a parser program (they use

(Please turn to page 214)





# WE SAW

That's right. **We saw!** Everything from big timber to a station wagon load of firewood. With big, almost 100cc chainsaws to bantam-weights you'd swear were miniature pro cutting machines.

We know you don't need a 100cc Pioneer around the cottage, house or for those small woodcutting chores. But you do need a chainsaw that'll give you one-pull starts, straight and true cutability, and dependability cut after cut, year after year.



So here's some straight-cuttin' talk from Pioneer... the Chainsaw people.

Pioneer's P12 and 1074 bantam-weights give you automatic chain oiling, quick, easy starting. P28 and P28 models give you

all that **plus** electronic ignition, heavy-duty clutch and much, much more.

What you don't get is an over-engineered, over-sophisticated or over-priced chainsaw. You get the functional features to get the job done. You get **value** — in the saw and in the price.

We saw, all right. We saw what you need in a chainsaw. And built one for you so you can saw — like a pro!



... the woodcutting machines

See the Yellow Pages for your Pioneer good neighbor dealer

# Carlton is lowest.



Box or Menthol:

## 10 packs of Carlton have less tar than 1 pack of...

	Tar mg./cig.	Nicotine mg./cig.
Kent	11	0.9
Kool	16	1.3
Marlboro Lights	12	0.8
Merit 100's	10	0.7
Virginia Slims	16	1.0

	Tar mg./cig.	Nicotine mg./cig.
Benson & Hedges Lights 100's	11	0.8
Pall Mall Light 100's	10	0.8
Salem Lights	11	0.8
Vantage 100's	12	0.9
Winston Lights	14	1.1

**Carlton Box—lowest of all brands.**

Less than 0.01 mg. tar, 0.002 mg. nic. Carlton Menthol—Less than 1 mg. tar, 0.1 mg. nic.

Box: Less than 0.01 mg. "tar", 0.002 mg. nicotine av. per cigarette  
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Menthol: Less than 1 mg. "tar", 0.1 mg. nicotine  
av. per cigarette, FTC Report Dec. '79.

Warning: The Surgeon General Has Determined  
That Cigarette Smoking Is Dangerous to Your Health.





# Two great 'tools' you can build for your workshop

Master craftsman C. E. "Doc" Banister made these tools for his workshop—and shares his plans so you can, too.

**T**his sturdy, vibration-free jointer stand is suitable for all 4- and 6-in. jointers. It's easy to keep clean and can be rolled into position on casters. The sawdust drawer collects chips and has handles at both ends for dumping. Casters can be quickly raised or lowered by foot levers.

Build the stand's frame first. The prototype was made of oak, but fir can be substituted if rail lumber dimensions are increased to  $1\frac{1}{2} \times 2\frac{1}{2}$  in. and legs to  $1\frac{1}{2} \times 3\frac{1}{2}$  in. Note the legs are splayed. Thus, dadoes (U-shaped notches for lower rails) and end rabbets (L-shaped cutouts for top rails) in legs must be made with  $7^\circ$  angle crosscuts. To lay out joints accurately, first cut the legs to length. (Compound  $7^\circ$  cuts are required at both top and bottom of legs.) Next, cut rails to overall dimensions given. Then lay legs on flat surface, in proper relationship to each other.

Position the upper and lower rails and trace for the cutouts. Do the same for each face on the stand. The top edge of the upper rails (B and C) must be beveled  $7^\circ$  to achieve a level mount for the tool.

## Mounting the jointer

All joints should be glued as well as bolted. Use  $\frac{5}{16}$ -in.-dia. lag screws where bolts are not feasible. The plywood drawer is assembled with glue and nails. For most jointers, the motor may be swung from a rod located between the top stretchers. The weight of the motor maintains the proper belt tension.

Bolting the jointer to the stand will also vary from model to model. Steel-plate and bar supports for heavy models distribute weight on rails;  $\frac{3}{4}$ -in. plywood will distribute weight of lighter units. Cut a hole in the plywood to allow cutter chips to

## Mobile stand for a 6-in. jointer



Stand's sturdy legs are splayed in two directions for stable, vibration-free operation of jointer. Space beneath the jointer houses a sawdust drawer and shelf for push blocks. Retractable casters let stand move easily.

shoot into sawdust drawer. In mounting a Shopsmith jointer, mounting tubes should be cut off so that they won't extend into the drawer area.

# MATERIALS LIST—JOINTER STAND

Key	No.	Size and description (use)
A	4	1 1/4 x 2 1/2 x 26" oak (leg)*
B	2	1 1/2 x 1 1/4 x 38 1/2" oak (upper side rail)*
C	2	1 1/4 x 1 1/4 x 12" oak (upper end rail)*

D	2	3/4 x 1 1/4 x 44" oak (lower side rail)*
E	2	1 1/4 x 2 x 18" oak (lower end rail)*
F	3	1 x 1 1/4 x 15" oak (brace)*
G1	1	3/4 x 11 1/4 x 15" plywood (drawer front)*
G2	1	3/4 x 11 1/4 x 13 1/4" plywood (drawer back)*
H	2	3/4 x 15 x 24 1/4" plywood (drawer sides)*
I	1	3/4 x 11 1/4 x 23 1/2" plywood (drawer bottom)
J	1	3/4 x 1 x 10 1/4" oak (pull and stop)*
K	1	3/4 x 1 x 7" oak (handle)*
L	4	3/8 x 1 1/2 x 1 1/2 x 6" angle
M	2	3/4 x 3 1/4 x 15 1/2" oak
N	4	3/4 x 4 1/4 x 15 1/2" oak
O	4	3/4 x 2 1/2 x 4" oak

P	4	retractable casters (Shopsmith)
Q	1	1/2"-dia. x 11 1/4" steel rod
R	1	motor mount (Sears)
S	2	3/4"-dia. x 2 1/2" carriage bolts
T	8	No. 8 x 1 1/2" machine screws, washers, lock washers, nuts
U1	4	3/4"-dia. x 3" carriage bolts, washers, nuts
U2	16	3/4"-dia. x 2 1/4" carriage bolts, washers, nuts
V	4	3/4" x 2 1/2" carriage bolts with Teenuts
W	12	No. 8 x 2" fir wood screws
X	2	1/2 x 3/4 x 3/4 x 24 1/2" angle irons

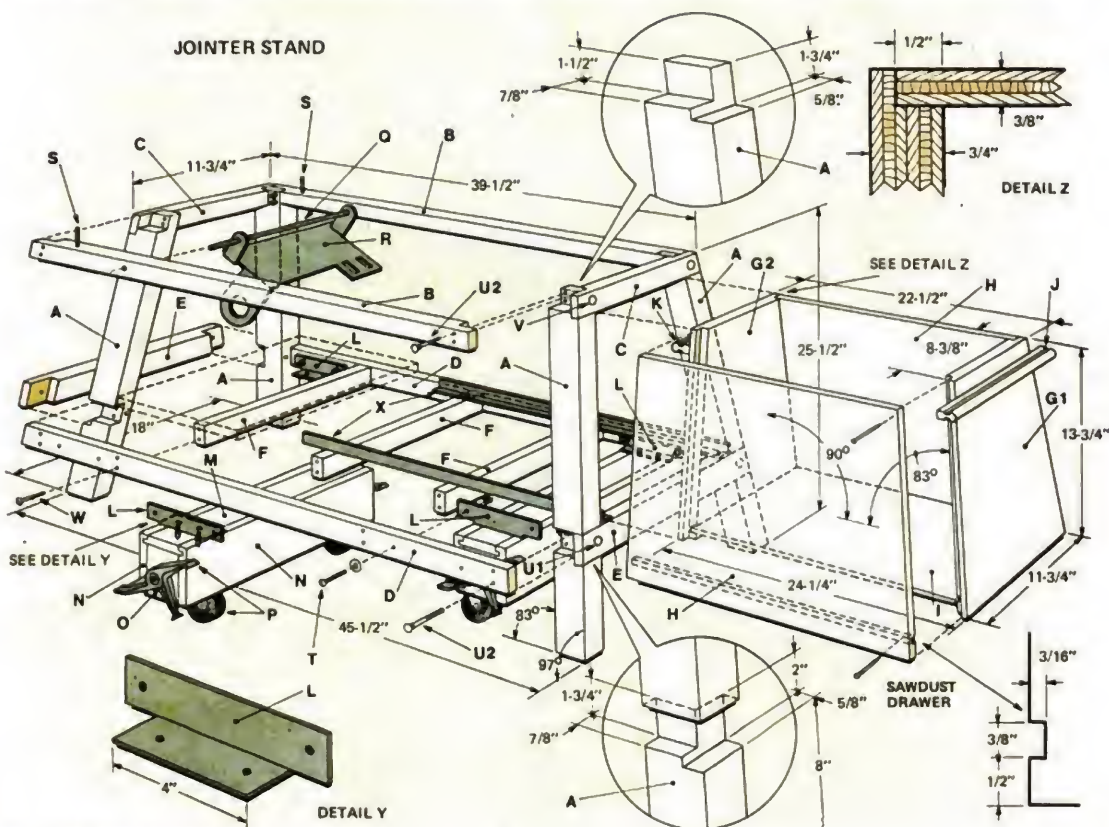
Misc.: White glue, 4d nails, sandpaper.

\*These are overall dimensions; pieces must be cut to fit.



Large sawdust drawer slides easily on the angle-iron tracks.

Shopsmith 4-in. jointer can also be accommodated by stand.





# Make this disc and drum sander

**B**esides being an excellent disc and drum sander, this inexpensive tool can perform other functions, such as buffing, wire brushing, deburring and light grinding. The adjustable table can be removed for buffing large objects.

If you desire, the mandrel speed can be varied by using a two-step pulley on the motor. Operate a 12-in. sanding disc at about 1725 rpm, an 8-in. disc as high as 3450 rpm for the most efficient work.

Start by making and assembling the end members. Install the mandrel support with lagscrews and the way supports with carriage bolts. Make the ways from 1 $\frac{3}{4}$ -in.-dia. round stock (or the largest available to you) and bore holes in J and K to suit. Slots, cut 1 $\frac{1}{2}$  in. deep in ends of ways, allow easy insertion.

The table is clamped to the ways with pieces B. These are made by clamping two pieces together and boring for the ways or by boring holes in a 3 $\frac{1}{2}$  x 3 $\frac{1}{2}$ -in. block first, then resawing to suit on a bandsaw. Plane about  $\frac{1}{16}$  in. off the inside faces of B after boring to ensure good clamping action. Tilt table is controlled by a miter-gauge head available from many tool dealers.

The mandrel unit must be carefully mounted so it's perpendicular to the miter slot in the table. The unit is available from Prairie Tool Co., Box 332, Prairie Du Chien, Wis. 53821, for \$15 postpaid. The  $\frac{1}{2}$ -hp, 3450-rpm motor is mounted to a

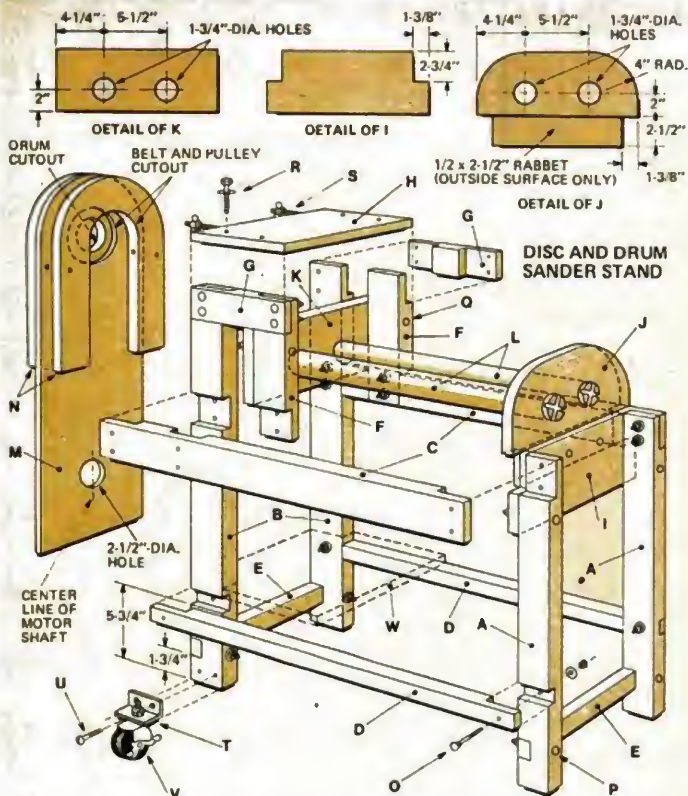
Drum smooths curved edge (shown), while disc can easily handle straight edges.



Stand boasts a guard for the belt and pulley and a tilting table.



Both guard and table are easily removed by undoing the wingnuts.



piece of 3/4-in. plywood, which, in turn, is attached to the motor shelf with a standard 3 1/2-in. door hinge. **PM**

#### MATERIALS LIST—SANDER STAND

Key	No.	Size and description (use)
A	2	1 1/2 x 2 1/2 x 21' oak or fir (leg)
B	2	1 1/2 x 2 1/2 x 29 1/2" oak or fir (leg)
C	2	1 1/2 x 2 1/2 x 28" oak or fir (rail)
O	2	1 1/2 x 1 1/2 x 28" oak or fir (side rail)
E	2	1 1/2 x 1 1/2 x 14" oak or fir (end rail)
F	2	1 1/2 x 2 1/2 x 11" oak or fir
G	2	1 1/2 x 2 1/2 x 7" oak or fir
H	1	3/4 x 7 x 14" oak or fir
I	1	1 1/2 x 5 1/2 x 14" oak, fir or pine
J	1	1 1/2 x 8 1/2 x 14" oak, fir or pine
K	1	1 1/2 x 5 1/2 x 14" oak, fir or pine
L	2	1 1/2"-dia. x 24" round stock (ways)
M	1	1/2 x 8 1/2 x 29 1/2" birch plywood
N	1	1/2 x 8 1/2 x 14" birch plywood (guard)
O	24	1/4 x 1 1/2" carriage bolts, washers, nuts
P	4	1/4 x 3" carriage bolts, washers, nuts
Q	2	1/4 x 4" carriage bolts, washers, nuts
R	4	2" lag screws
S	2	1/4 x 4" hanger bolts, wingnuts (guard fastener)
T	4	3/16 x 1 1/2 x 1 1/2 x 2 1/2" angle iron
U	8	1/4 x 2" flt stovebolts
V	4	2" Black & Decker locking casters
W	1	1/2 x 14 x 14" plywood (shell for motor)

#### MATERIALS LIST—SANDER TABLE

A	2	1/2 x 3 1/2 x 6" oak, fir or pine
B	2	1 1/2 x 3 1/2 x 10 1/2" oak, fir or pine
C	1	1 x 1 x 15" oak (leveler, nail to carriage)
D	1	1 x 15 1/2 x 18 1/2" birch plywood [glue 1/4" to 1/4" piece]
E	4	1/4 x 1" x length to suit birch edging
F	2	1 1/2 x 1 1/2 x 14" oak or fir
G	1	1/2 x 1 1/2 x 6 1/2" oak or fir (spacer)
H	1	Cast-iron or oak miter head
I	1	3/4"-dia. x 12 1/2" steel rod
J	3	1/4"-dia. x 3 1/2" carriage bolt, nuts, washers
K	1	1/4"-dia. x 3" carriage bolt, nut, washer
L	1	1/4 x 4 1/2" carriage bolt, nut, washer
M	6	No. 8 x 2 1/2" flt screws
N	2	No. 7 x 1 1/2" flt screws
O	8	No. 8 x 2" flt screws

\*These are overall dimensions; pieces must be cut to fit.

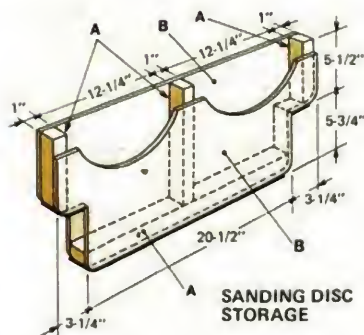
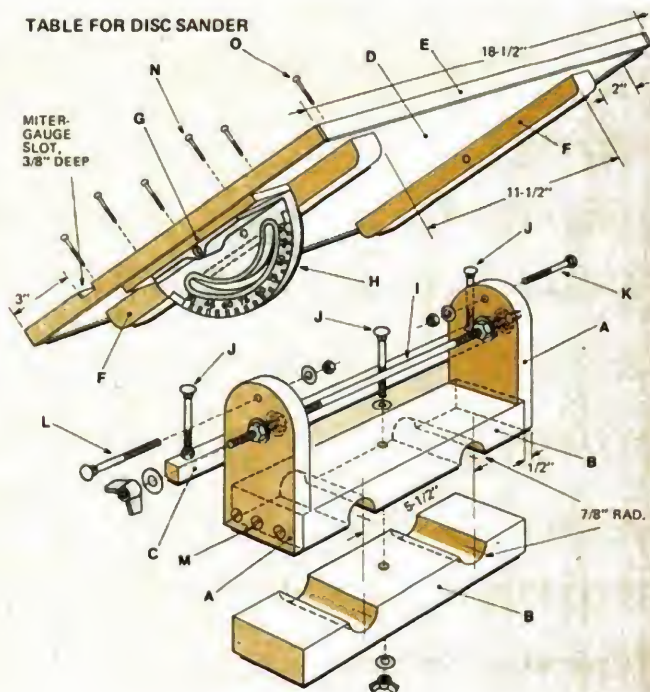
#### MATERIALS LIST—DISC STORAGE

A	4	1 x 1 1/2 x length to suit (space blocks)
B	1	1/2" plywood, cut to suit

Misc.: White glue, 1/4" brads as required.



TABLE FOR DISC SANDER



SANDING DISC STORAGE



# Now NRI takes you inside the world's most popular microcomputer to train you at home as the new breed of computer specialist!

**NRI teams up with Radio Shack to teach you how to use, program and service microcomputers...make you the complete technician.**

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 200,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

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(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)



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Can your  
lawn and garden tractor  
raise corn?





Naturally your lawn and garden tractor can cut the grass. But can it cut the mustard when it comes to heavier work? Can it help you raise corn? Can you use it to grade that new driveway? Can it dig a trench? Or a post hole?

### **OURS CAN.**

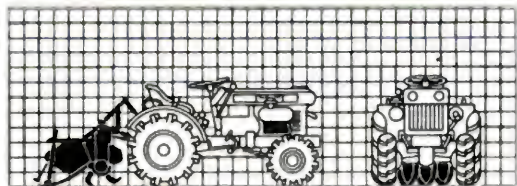
The Kubota B7100DT, pictured opposite, is one of our best-selling tractors. And no wonder. It's a demon for hard work. In fact, you won't find another 16 hp tractor in America that can do more kinds of jobs, from mowing the lawn to heavier chores like plowing, tilling, digging, and lifting.

### **WHAT'S OUR SECRET?**

It's no secret. It's just the way we go about building our tractors. The Kubota B7100DT is not a beefed-up riding mower. Instead, it is a scaled-down farm tractor, complete with such farm-type features as a fuel-saving diesel engine, 4-wheel drive, 6 forward and 2 reverse speeds, rear PTO, and a 3-point hydraulic hitch.

### **READY AND WILLING.**

The way it's designed, the B7100DT is ready and willing to accommodate a wide variety of Kubota implements. Your Kubota dealer can easily equip your tractor with any or all of the following: mid-mount or rear-mount mower, rotary tiller, plow, disc harrow, rear blade, front blade, trencher, front-end loader, backhoe, post hole digger, and snowblower.



Rear-mount tillers are available for all Kubota tractors.

We're now in our second decade of selling tractors in America, and one of the reasons for our success is the quality

and commitment of our national sales and service organization. Besides the B7100DT, your local dealer can show you many other Kubota models ranging from 12 to 81 hp. So if you're looking for a hard-working mid-size tractor, please remember, our Kubotas are looking for work.

**INFORMATION PLEASE!** I'd like more information about the Kubota B7100DT and all your other fine tractors. Please rush me a free copy of your latest brochure.

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Kubota Tractor Corporation, 550 W. Artesia Blvd.  
P.O. Box 7020, Compton, CA 90224

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 **KUBOTA®**  
We're looking for work.

# APPLIANCE CLINIC

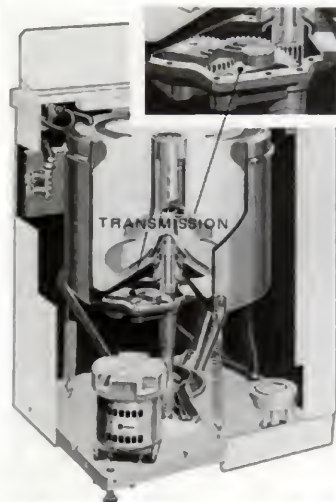
## QUESTIONS ANSWERED

### Slow-starting agitator

*I recently bought a used Maytag clothes washer, Model KA-206, and installed it in our unheated daylight basement. The agitator moves quite sluggishly for about 10 minutes of the wash cycle before it begins to agitate normally.*

*An appliance repairman said that probably the grease in the transmission is stiff until it warms up. Is there anything I can do to overcome this problem, short of heating the basement all the time? What about heat tape? I bought some, but was scared off by all the warnings regarding inappropriate use.—James Enslow, Langley, Wash.*

Last things first: Don't use the



If transmission is sluggish when machine starts, check packing grease. If grease is too thick, replace with thinner lubricant.

heat tape! You are right; it's too risky. There are too many moving parts inside a washer to install anything like heat tape with safety.

You have a special problem. Maytag (as do other manufacturers) recommends operation of its machines only at normal room temperatures. The machines are not built for use in unheated areas of a home.

A Maytag spokesman agrees that the grease in your transmission may be too stiff until the machine warms up. He also warns of other problems you risk by operating your washer in an unheated area, such as water freezing in the lines or pump.

He did say, however, that Maytag has a special lightweight grease you can use to repack the transmission. Better yet, he said to let an authorized repairman do it, as it is a ticklish job requiring at least two special spanners to reach critical bolts. If you want to tackle it yourself, order part No. 56080, a 34-ounce container of 140-weight grease.

You don't say how "unheated" your daylight basement really is. But if cold is not stiffening your grease, the source of your trouble, we think, is the boot seals on the transmission. These sometimes leak. If they do and water gets into the housing, the result is much like that induced by cold: The grease gets stiff and sluggish.

I would definitely check the boot seals for any leaks. Then I would think about tackling the repacking job. Operating the unit in a heated area may be your best solution.

### Frost on the pumpkin

*We are having a problem with our frost-free Sears refrigerator/freezer, which we purchased in 1965. Our problem is ice formation in the vegetable bins and the covered Tupperware outside of the bins. The temperature inside the unit is 40° F.—Nick Yaksie, Rancho Cordova, Calif.*

A puzzler, perhaps, but let's see. You can't get ice without moisture, and you can't get ice at 40° F. Let's start with the obvious: Are you storing wet vegetables? If you wash them before storing (a bad practice, anyway), at least be sure to shake them thoroughly.

You may also have a leaky door gasket, which permits the moisture to enter the box; but in sunny California, we doubt that this is the problem.

We think you have a double thermostat that is not working properly. It controls both the upper freezer compartment and the lower refrigerator. What may be happening is that intermittently the thermostat in your refrigerator is letting the freezer compartment thaw a bit.

Most two-section, over-and-under refrigerator/freezers are internally connected via drain holes. These can let excess moisture pass into the refrigerator. Here it is obvious that the temperature at the level of the bins is hitting 32° F., letting ice form. This further suggests that the thermostat is wacky. We suggest you re-

place it and see if that doesn't cure the problem.

### A rose by any other name

*My problem is the foul odor emanating from my hot-water tank. Neighbors tell me that the odor probably is caused by the anode and that I should remove or disconnect it to eliminate the smell. What do you think?—Charles Katzer, Dover, Del.*

Most hot-water storage tanks today are glass-lined. The heating coil is the only metal in contact with the water. To avoid electrolytic decomposition of the coil, manufacturers install an anode or "sacrificial anode," which undergoes electrolytic attack instead of the coil.

It is conceivable that you have a cracked liner that lets water contact the tank walls, negating the role of the anode. Then again, you may also have contaminated water in your system—containing sulfur or some other smelly material. Town sanitation departments will often test your water free of charge, and similar programs are offered by firms like Culligan and Sears, Roebuck and Co.

A check with a Culligan service rep confirms your suspicions about the anode. He told us that these are magnesium rods and that they do, indeed, cause an undesirable taste in water in many communities. He routinely removes them from tanks in his area. Over a period of time he has found no shortening of tank life. He believes such anodes have a very short effective life, at best. He recommends removal of the anode to improve your water.

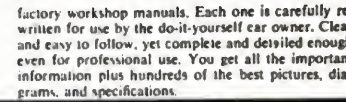
### SERVICE TIP

Over 90 percent of the energy used in washing clothes goes for heating the water, according to Speed Queen. To conserve energy and produce good results when washing, the company suggests that homeowners set their water heaters at 140° F. Setting the temperature substantially lower without pretreating clothes may produce these unsatisfactory results: 1) the detergent may not completely dissolve; 2) streaks or spots may show up on dark-colored clothing; 3) white items may become gray; 4) greasy or oily soil may not be removed entirely and may show up as large gray stains.

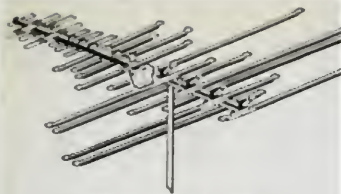
FM

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



[illegible]





## FOR BETTER TV & FM BETTER GET WINEGARD!



### OUTDOOR ANTENNAS

Improve your TV picture with a new Winegard antenna. Patented design assures more signal . . . you get rid of ghosts, snow, weak color. Anodized, rugged, gives you strong, clear reception on all channels.

### FM STEREO ANTENNA

Indoor antenna with solid-state amplifier reduces or eliminates multipath distortion, strengthens weak, fading stations an average of 5.6 times. Sits on or near FM tuner. Model FM-4400.

### INDOOR TV-FM ANTENNA

Improves both TV pictures and FM sound. Perfect for apartments, dorms, homes. Goes up fast, easy. Complete package, including wire and plant hanger hooks. Model AT-5001.

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Extends range of auto FM stereo for more stations. Amplifies signals an average of 8 times. Reduces fading. Fits under dash, with only switch visible. Model BF-8809.

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Emergency garage-door lifter release lets you unlock the door in event of power outage.

# Don't get locked out! Add an opener release to your garage door

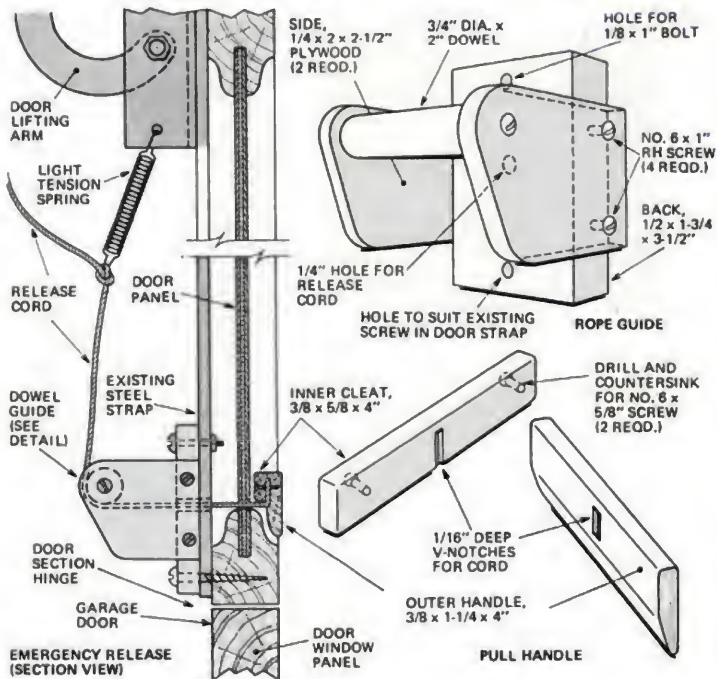
If your garage is detached, with no side entrance or unlocked window to climb through, the emergency release cord of your automatic door opener will be locked inside if a power failure occurs. After power outages twice kept us from using the car, I decided an outside release cord was a necessity.

To rig the release, attach five feet of drapery draw cord to the latch re-

lease lever alongside the regular release cord. Route the new cord under a guide centered on the door. Thread it through a hole to an outside pull handle.

Leave slack in the cord so that when the door is raised to its full-open position, the cord won't be so tight as to release the latch. Position a very light tension spring to take

(Please turn to page 42)





# DO-IT-YOURSELF SIDING!

You can re-side your home yourself with one of our nationally advertised aluminum, vinyl or steel siding HOME-KITS... and then make as much as \$1000 per order by selling HOME-KITS to your friends and neighbors. Here's how it works. If you own a home which needs siding, you can become a part-time (or full-time) siding dealer for Aluminum Industries, America's largest mail-order siding distributor. To be eligible for a FREE dealership, you must apply one of our kits to your own home. Of course, you'll buy your kit at our wholesale dealer's cost, which is about 1/3 below the national average applied siding cost. Then, when your friends and neighbors see how beautiful your home is, you'll find it quite easy to sell them a HOME-KIT for their own homes. If you choose, you can make even more money by applying the kit for them.

Our HOME-KITS are composed of the finest aluminum, vinyl, or steel siding available, and once you've installed a kit on your home, you'll have the confidence to sell them. You'll be able to talk first-hand about how great these kits really are. All materials necessary for a durable and professional looking job are included in our HOME-KITS. In addition to the siding panels themselves, you'll receive all of the accessories for the finishing touches... such as window trim, door trim and pre-shaped corner moldings... we even include the proper nails.

HOME-KITS are available in 14 sizes and in 22 colors. And your first kit comes with professional siding applicator's tools at no additional charge. Fill in the coupon below, or call us toll free at 1-800-643-9904 for a FREE ALUMINUM INDUSTRIES DEALERSHIP.

## QUESTIONS AND ANSWERS ABOUT HOME-KITS

### WHAT IS A HOME-KIT?

A HOME-KIT is a complete kit of either aluminum, steel, or vinyl siding for covering a frame home. The dealer's first kit consists of all the siding, accessories, and tools for covering a certain size home. HOME-KITS come in 14 different sizes. Complete installation instructions are included.

### IS IT HARD TO APPLY ALUMINUM, STEEL, OR VINYL SIDING?

No. If you can drive a nail and cut on a straight line with tin snips, you can apply siding. Our instructions are very easy to follow.

### WHAT ARE THE PRICES OF HOME-KITS?

Our wholesale dealer prices are about 1/3 the national applied price. If you would like to become one of our part-time dealers (or a full-time dealer) just fill out the coupon and mail it to us or call us toll-free at 1-800-643-9904. We will send you our CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST. We will not bother you with a personal visit. No salesman will call on you.

### WHAT DO I HAVE TO DO TO BECOME A DEALER?

We require all our dealers to apply one HOME-KIT to their own home to qualify for a dealership.

You can work as a part-time or full-time siding dealer. Most of our dealers are part-time workers... they use the HOME-KIT as a method of supplementing their regular income.

### CAN I BUY MY FIRST HOME-KIT ON TIME PAYMENTS?

Yes indeed... in fact most of our dealers buy their first HOME-KIT on either an FHA Home Improvement Loan Plan or with our special \$7.00 per week plan with no interest and no carrying charges.

## Examples Of The Types Of Homes Which Can Be Covered With Home-Kits.



"Get more information by filling out coupon."

"Order and apply HOME-KIT to your home. It's easy... and beautiful!"

"Sell your friends and neighbors. They'll never have to paint again."

"EARN SUPER PROFITS! National average installed price is 3 times your dealer cost!"

### HOW MUCH WILL I SAVE BY BUYING HOME-KITS?

Our HOME-KITS are priced to our dealers at about \$2,000.00 less than the national average applied price. You will be amazed at how inexpensively you will be able to buy a complete siding kit, including all accessories and all tools.

### HOW DO I GET A DEALERSHIP?

If you own a home which is suitable for the application of siding, your first step is to mail in the coupon or call us toll-free at 1-800-643-9904. If we have an opening in your county for a part-time or a full-time dealer, we will let you know. There is no charge for a dealership except in the purchase of your first HOME-KIT. You are under no obligation by mailing the attached application.

### WHAT WILL I GET WHEN I CALL OR MAIL IN MY DEALER APPLICATION COUPON?

We will promptly mail to you a CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST and free samples of the various types of siding we distribute. You will also receive a certificate that will tentatively "hold" a dealership for you in your county, if one is still available.

## EARN UP TO \$1000 PER SALE



## ALUMINUM INDUSTRIES OF ARKANSAS

300 Phillips Rd. North Little Rock, AR 72117

## APPLICATION FOR DEALERSHIP Dept. PM10

WITHOUT OBLIGATION, please mail me all of the materials mentioned above including my FREE 48-page CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST, DEALERSHIP, AND SAMPLES. I own a home which needs to be re-sided and I understand that I must purchase a HOME-KIT for my home before I can sell them to the public. NOTE: No salesman will knock on your door, we distribute exclusively by mail.

My name is: (please print) \_\_\_\_\_

I would like to be considered for a: ☐ Part-time ☐ Full-time dealership

STREET ADDRESS: \_\_\_\_\_

(The above address must be that of your home which you are considering re-siding.)

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

COUNTY \_\_\_\_\_

My phone number is: \_\_\_\_\_

SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

Mail Coupon or Call Toll-Free 1-800-643-9904.

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## "It's a little Beast. Guaranteed!"

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**UNCLE  
HENRY**  
Elizaville N.Y. 12428



## DON'T GET LOCKED OUT

(Continued from page 40)

up slack and hold the pull handle snug against the outer surface of the garage door.

The cord guide is simply a base block with two 1/4-in. plywood sides to support a 3/4-in.-dia. dowel around which the release cord runs. This guide can be attached directly to the garage door, or, as in my case, can be mounted to the steel strap to which the automatic door lifter arm is attached.

Drill the necessary holes for mounting the guide and for exiting the release cord through the base and support.

## Camouflage the pull handle

The pull handle should be as inconspicuous as possible to avoid unwarranted entry. Drill the 1/4-in.-dia. exit hole at the inner contoured edge of a door panel frame and at a convenient height. Make the pull handle as shown and clamp the cord end securely between the pieces. Once in place, it is important that the cord should blend with the door framing



Cord, tied to existing release lever and tensioned by spring, is threaded under guide and through hole in door (to pull).

as much as possible. Paint the pull handle a color to match the garage door.

Although all the drawing and photos show the outside release-cord arrangement on a sectional garage door, this scheme will work out just as well on a one-piece garage door.—  
Wilson G. Walters.

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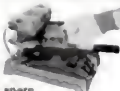
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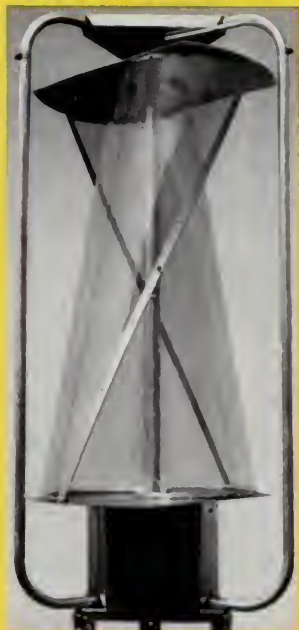
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**HELIUS TC25K**  
**VERTICAL AXIS WIND GENERATOR**  
 ONLY \$379 COMPLETE KIT  
**ASSEMBLE IT YOURSELF!**

**TC25K SPECIFICATIONS—SELF-STARTING—CONSTANT TORQUE—QUIET—SAFE SELF-LIMITING ACTION AT HIGH WIND SPEEDS.**

- Dimensions—Height 4 ft. 6 in. (1380mm) diameter 2 ft. 10 in. (760mm)
  - Weight—47 lb. (21.4 kg) (Shipping weight—56 lb. (25.5 kg))
  - Rated operating power—25 watts (12.5 volts at 2 amp dc)
  - Maximum power—150 watts. Rated power at 22 mph (37 km/hr)
  - Voltage range 6-12-24-36 with appropriate voltage regulator
  - Convertible to 110 vac by static inverter
  - Materials—Vanes: super-tough Luan, unaffected by cold or exposure
  - Structure: 6061T6 aluminum alloy and anodized/aluminumized steel. Top quality materials and hardware.
  - Bearings: sealed permanent-lubed deep-groove ball bearings.
  - Generator included: one TC25K dc generator is packed with each kit
- COMPLETE ASSEMBLY, ERECTION AND OPERATION INFORMATION SUPPLIED WITH THE KIT.**

## SPECIAL INTRODUCTORY OFFER

MAIL TO—  
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 2641 NORTH MAIN STREET  
 WALNUT CREEK, CALIFORNIA 94596

**TC25K HELIUS ROTOR KITS** Please ship me \_\_\_\_\_ kits for **ONLY \$379** each (2 for \$720) plus \$20 per kit for shipping and handling in continental USA or Canada.

**TC25G GENERATORS**—Please ship me \_\_\_\_\_ generators and free plans for **ONLY \$69** each (2 for \$130) plus \$3 each for shipping and handling in continental USA or Canada.

My money order, check or credit card information, is enclosed  
 (California residents please add 6% sales tax)

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**SATISFACTION GUARANTEED**—If you're not completely satisfied with your TC25K Helius Rotor kit or TC25G generator, return it to Thermax in original condition within 10 days of receipt for a prompt refund. Please allow 2-4 weeks for us to process and ship your order.

**A NATURAL ALTERNATIVE TO EVER-HIGHER FUEL AND POWER BILLS**

# FREE ENERGY!

## START GENERATING YOUR OWN POWER FROM THE WIND

**USE IT TO CHARGE BATTERIES**—for emergency power, lights, water pumps, portable power tools, solid-state refrigerators. For cottages, boats, RV's, camping. Mounts easily on a TV tower or pole.

**WIND SURVEYS**—The TC25 can show you exactly how much wind energy you can get from any site, and its variation through the seasons. Use the TC25 to find out whether it will pay you to install a large wind generator, and where to find the best wind site.

**ELECTRIC VEHICLES**—Get a "Free Ride"—build your own experimental electric vehicle and charge it from the wind. The TC25K gives you the hands-on experience you need to handle the larger full-scale electric car systems.

### HOW TO BUILD A SMALL WIND GENERATOR THAT WORKS—AND STARTS WORKING—

Until now, it was no easy task to build your own low-cost wind generator. So Thermax engineers set out to design a completely new type of windpower converter, that anybody could assemble with simple tools. It had to be very low in cost, sturdy, reliable, and safe in high or gusty winds. It also had to be omnidirectional (meaning that the rotor must capture the full energy of the wind from all directions, without swiveling around to face into the wind).

### WE TESTED THEM ALL—

The performance and cost of many known rotor types were carefully compared. Finally, by a process of elimination, our engineers selected the simple and durable Savonius rotor. Then they set to work improving it further, to eliminate such problems as cyclical torque output (that is, Savonius power is delivered in pulses, and a Savonius rotor could be stalled at its lowest torque position).

### THE PROBLEM SOLVED—INVENTION OF THE HELIUS ROTOR—

The solution turned out to be simplicity itself. Everybody knew that the torque characteristic of a Savonius rotor could be improved—at some cost—by stacking two or more phase-shifted rotor segments. Thermax engineers reasoned that the ideal torque output would theoretically be achieved by stacking an infinite number of such rotor segments, and so they invented the "Helius" rotor. The 90-degree twist of the vanes gives this rotor a completely smooth output torque. The problem was solved, and a new type of rotor had been born! Patents were applied for, and a brand new product was developed and prepared for the fast-rising renewable energy market.

### THE MARKETING EXPERTS WERE WRONG—AGAIN!

At first they told us that nobody would ever want to own a small wind-power system—less than kilowatt size. But renewable energy enthusiasts and educators, who could see only too clearly the future of world energy supplies, kept asking us for a low-cost but effective wind generator to power a weekend cottage, for RV's, electric fences, battery charging, school energy projects, and many other small-scale uses. Now, our customers tell us the TC25 Helius Rotor is "exactly what we were looking for"—they proved the experts wrong again!

### GET THE FEEL OF WIND ENERGY—WITHOUT SPENDING A DIME!

You really save by assembling your own Helius rotor. You pay only for the highest quality components and hardware. Each rotor kit comes complete with a user's guide—all you need to know about assembly, installation, operation, wiring, batteries, regulators and inverters. You don't have to be an expert to put the TC25K kit together—just a few hours, with clear step-by-step instructions and ordinary hand tools, and your energy independence begins! All you need to complete your installation is a TV tower or other mounting and, of course, a battery and regulator.

**A VISUALLY ATTRACTIVE**  
**"SCULPTURE IN MOTION"**  
 —ENHANCES YOUR YARD

## FEATURING—THE AMAZING NEW TC25G PERMANENT MAGNET LOW-RPM DC GENERATOR



Each Helius rotor kit comes complete with one TC25G generator, which was specially designed for small-scale renewable energy applications.

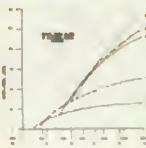
You can buy this generator alone for **ONLY \$69** (two for \$130) and get a complete user's guide as well as **FREE PLANS** to build three new energy products.

- **WATER POWER**—Construct your own small hydroelectric power station.
- **WIND POWER**—Build a Helius rotor from plans.
- **PEDAL POWER**—Convert a bicycle to generate electricity. Pedal your television set!

**TC25G SPECIFICATIONS**  
 LENGTH—8 1/2 in. (214 mm) DIAMETER 3 1/4 in. (82 mm)  
 SHAFT DIAMETER 5/16 in. (7.94 mm) WEIGHT 3.5 lb. (1.6 kg)

### ELECTRICAL PERFORMANCE (SEE GRAPH)

Rated Voltage	12 Volts	Peak Voltage	100 Volts
Rated Current	2 Amps	Peak Current	7 Amps
Rated Power	25 Watts	Peak Power	150 Watts





# PM ELECTRONICS MONITOR

## Amazing new antenna design

Whenever you change frequencies to transmit or receive, a different antenna length is desirable. An antenna that works great at one frequency may be far too short or too long to work right at another frequency.

Right now, most adjustable antennas require a physical telescoping of elements to regulate length (such as a television's rabbit ears) or electrical "traps" such as a ham's trap dipole antenna. Both methods have certain limitations.

A revolutionary concept has been developed and a patent applied for. It is a *liquid* antenna. A liquid conductor (such as mercury) is controlled by gas pressure within a non-conducting tube. The height of the liquid antenna (the mercury column) is regulated to give the best length for the frequency being used.

This regulating can be done by remote control, either manually or with a feedback-sensing device. A microcomputer could be used to adjust the antenna instantly and automatically to compensate for the frequency it will be used on.

For the average listener, this would mean no more adjusting and readjusting your radio or TV antenna, better performance and greater capability to hear "weak" stations. For professionals, it may mean much cheaper antenna installations.

As yet, the patent has not been licensed for manufacture. Those interested are invited to contact Donald Wilson, Box 651, Encinitas, Calif. 92024.

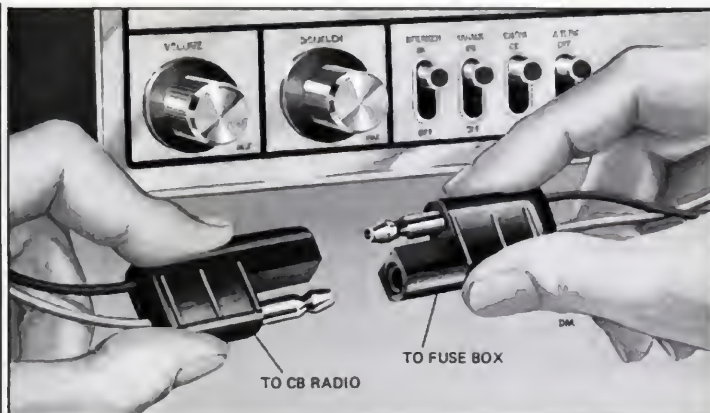
Liquid antennas may be the wave of the future (if you'll forgive the pun).

## TV for the deaf

Millions of handicapped and partially handicapped people have been cut off from enjoying television. Without good hearing, it's impossible to follow most TV shows.

There is now a "closed-captioning" system of TV viewing. ABC, NBC and the Public Broadcasting Service each offer about 20 hours of programs that include captions for the deaf. An adapter or special TV set is needed to see these captions.

Sears sells the adapter for about \$250 and a TV with a built-in adapter for \$520. If you or a friend are hard of hearing, this is certainly worth investigating.



## Foil that CB thief

I have a friend who is now on his fourth CB set in two years. The first three were all stolen from his car (one when it was left unattended for only 10 minutes in his own driveway). He hopes this fourth set will last a while longer—because he has installed it so it can be easily removed from the car. When he is not in his car, he'll take his CB set along with him.

His CB set is wired to his fusebox, but with the addition of a *polarized plug* in the d.c. line so that he can quickly unplug the set. Then he has only to remove the antenna connection and take the set from its bracket—and leave

with the CB unit in a carry-along canvas bag.

The plug costs less than a dollar at any electronics store. Be sure it's the polarized type. This means it will only go together one way, with no danger of plugging it in backward and shorting out your set.

While not as convenient as a sliding mount (which makes and breaks all connections automatically), it is about \$12 to \$20 cheaper. Another advantage is that you only carry the CB set with you, not half of a heavy sliding mount as well.

Burglar-proof your CB—today!

## I've been waiting forever!

You may call a long line at a bank or cashier an annoyance (or worse), but it is technically a *queue*. And how long is an aggravating queue?

Well, a company called Bank Data Bank has invented the Q-Minder. This little device uses motion detectors to watch the line and a computer to process the information.

It then presents the information as plotted curves or numeric read-outs. The information may be useful in helping to shorten the waiting time by better utilizing personnel. More information can be obtained by contacting Bank Data Bank Co., Box 80, Carle Place, N.Y. 11514. The line forms to the left.

## No graphics, but beautiful

Many home computers offer some very nice color and graphic capabilities. But it isn't true that a program must use these capabilities to be enjoyable. Avalon Hill, a major game company, just entered computer gaming in a big way. It's releasing a series of games for the Apple, TRS-80 and Pet computers. Each program is recorded in three different formats so that you can load it into

any of these three home computers.

But because the computers all have different graphic commands, Avalon Hill did not use graphics. Still, the games are quite good. We looked at one, *Planet Miners*, that prints a respectable solar-system map without special graphics.

A smaller company, Dynacomp, also has some nongraphic programs for the Apple and TRS-80. One, called *Valdez*, is a richly detailed simulation of a supertanker mission.

Avalon Hill products are available in many stores or you can order them from Avalon Hill, 4517 Harford Rd., Baltimore, Md. 21214. Dynacomp's address is: Box 162, Webster, N.Y. 14580.

PM





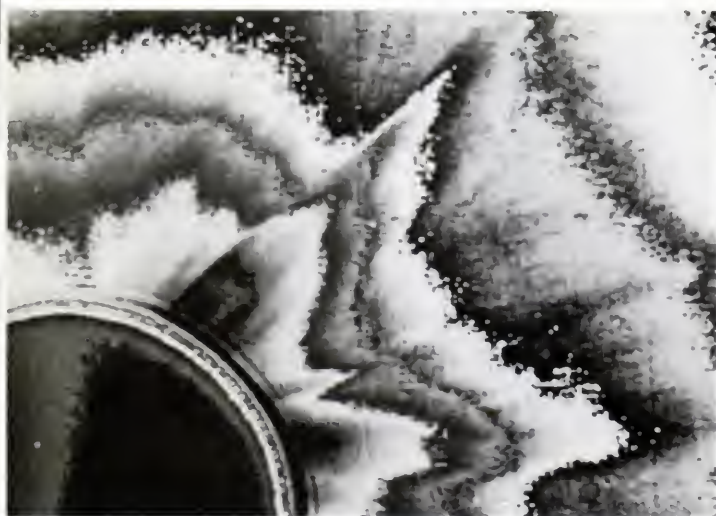


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# SCIENCE WORLDWIDE



Satellite data provided view of sun's surface, where temperatures range up to 10,000° F.

## Portrait of a star

The picture above of our sun came from instruments aboard a satellite that may help scientists produce more energy on Earth.

The picture was made with data from a coronagraph/polarimeter, an instrument on the Earth-orbiting Solar Maximum Mission spacecraft launched last February by the National Aeronautics and Space Administration (NASA). The prominent spike angling off to the right is a streamer of gas extending more than a million miles from the surface.

Spectacular as the image is, NASA scientists were even more pleased by a sudden flood of data from the satellite shortly after this picture was received. Later transmissions revealed evidence of a huge solar flare, a sudden violent explosion in the sun's atmosphere, which disrupted radio communications on Earth for more than half an hour. Temperatures in the core of the flare, the satellite indicated, reached more than 100 million° F. NASA researchers were unable to construct a picture of the flare itself because of its angle: It shot almost directly at Earth.

Flares are particularly interesting because they are natural examples of fusion, the combining of hydrogen ions with a release of energy. Many university labs are trying to duplicate the action of the sun in containing hydrogen ions in mag-

netic fields until they fuse and emit heat. The goal: to capture the heat and generate electricity, using principles as old as the sun.

## Direct line to the brain

Stanford University researchers are on the verge this fall of implanting an "artificial ear" into a test subject.

Unlike a standard hearing aid, which amplifies sound, the Stanford device would convert sound into electrical signals to stimulate the firing of neurons in the auditory nerve. "We are, in effect, attempting to trick the brain into thinking the ear is working when actually it is not," said Prof. Robert White, director of the Institute for Electronics in Medicine at Stanford. The Stanford ear comprises an external box to convert sound to electrical signals and transmit them to a receiver the size of a quarter implanted in a cavity above the ear. The receiver, in turn, sends signals to nerves leading to the brain.

Previous models have given deaf people speech cues and clues, to help them know when a telephone is ringing or someone is knocking at the door. The latest model has been designed to provide full speech comprehension.

## A plea to the Soviets

Several U.S. scientists have urged the Soviet Union to take the lid off information about a possible nucle-

ar accident more than 20 years ago.

Researchers John R. Trabalka, L. Dean Eyman and Stanley I. Auerbach reported further evidence of the accident in the Ural mountains, about 1000 miles east of Moscow, in the winter of 1957-58. It apparently involved the release of fission wastes into the air, possibly because of the use of dangerous and now-obsolete storage techniques at a military site. Russian papers have maintained that contamination around the Kashi area was the result of the calculated application of radioisotopes for environmental studies. But American researchers contend that Soviet publications are uncharacteristically vague about which specific sites were involved in the studies.

Writing in *Science* recently, the authors urged the Soviet scientific community to share information on what really happened as a contribution to the safe development of nuclear energy.

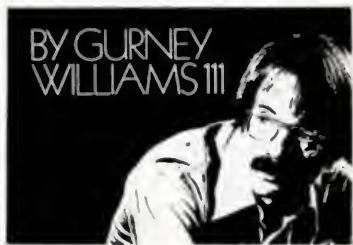
## Looking with sound

Electron microscopes have given scientists a glimpse at the world of atoms ("Mining Atoms in the Gold," *Science Worldwide*, page 12, Oct. '79), but they have one large disadvantage: They can't be used to examine living cells because specimens are held in a vacuum.

Now some California physicists are close to developing a new kind of microscope, using high-frequency sound, that could keep these cells alive while researchers are studying them.

Prof. Calvin Quate at the Ginzton Laboratory of Applied Physics at Stanford heads a team working on an acoustical microscope. Similar in principle to a sonar set, it beams sound through short sapphire rods at a target specimen, then collects sound energy scattered by the object. "Echoes" provide a picture of tiny organisms, without killing them.

FM





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Pall Mall Light 100's	10 mg. tar 0.8 mg. nic.
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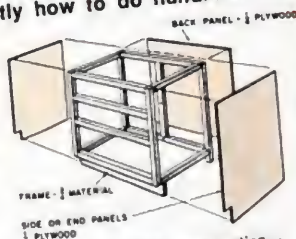
# FEIRER CABINETMAKING AND MILLWORK

# CABINETMAKING AND MILLWORK

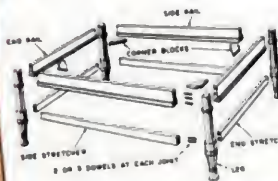
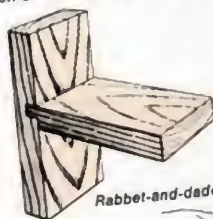
Thousands of explanatory drawings illustrate important points and show you exactly how to do hundreds of woodworking jobs...



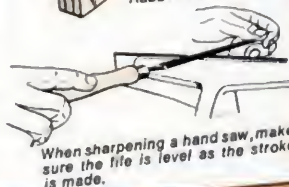
The two basic methods of turning on a lathe: cutting (top) and scraping.



This is frame construction—often used in kitchen cabinets.



Exploded view of coffee table showing leg-and-nail construction using dowels and corner blocks.



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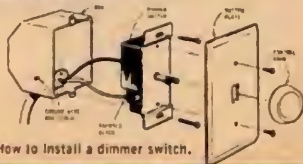
How to determine wiring needs. How to draw up plans for "go-aheads". How to install complete systems. And how to wire low-voltage devices (intercoms, etc.), rural buildings, service entrances, workshops, heavy-duty machines, appliances—everything!

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# HOMEOWNERS' CLINIC

## QUESTIONS ANSWERED

### Crazed lavatory

*In our bathroom, we have a marbleized plastic vanity top. The countertop still looks new, but the lavatory is disfigured, with a network of fine surface cracks, similar to crazing in chinaware. Heavy hand sanding did not remove these cracks. As replacement would be difficult and expensive, is there a special plastic paint or coating I could use to fill these cracks?*—Lester L. Myers, Fort Wayne, Ind.

A check with one source that has manufactured these countertops for 13 years brought out the following: You can purchase a clear, casting resin such as 132 Alplex, which is made by Adhesive Products. It's available at hobby stores or plastic suppliers.

After fine-sanding the work surface, mix the material and apply it with a brush. Clean the lavatory thoroughly and be sure to follow mixing instructions. A fine sanding preceding a second coat may be required. Wear gloves and goggles, and ventilate the work area while applying.

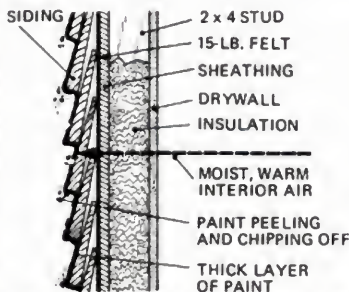
### Mildew and peeling paint

Both J.J. Coyle, Charlottetown, P.E.I., and Edwin W. Stewart, St. Mary's City, Md., have similar problems with mildew appearing on inside walls and paint peeling off outside walls. Both added insulation.

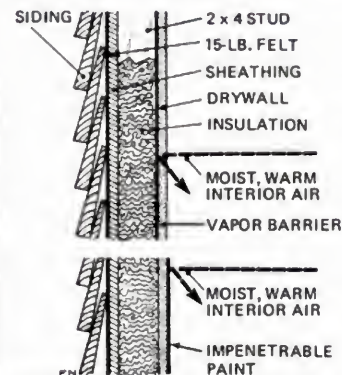
This is a problem that is not only common, but becoming classic. The interior walls must be painted or otherwise treated to prevent warm, moisture-laden air from passing through the walls and reaching the

cold outside surface. When the paint on the exterior surface prevents the wall system from breathing, the moisture leaving the house causes the paint to "pop" off.

There are several paints manufactured to help minimize such problems. Glidden's Insul-Aid, for example, is an interior paint that prevents the moisture from passing through the inside wall. (See "Rotting roof," *Homeowners' Clinic*, page 22, Oct. '79, and "Vapor-barrier update," *Homeowners' Clinic*, page 82, Apr. '80.)



Thick paint on siding prevents wall from "breathing." As a result, vapor can't pass through without popping off paint.



Install the vapor barrier over the studs behind the drywall during construction (top of drawing). Or, apply the vapor barrier in the form of impenetrable paint after construction (bottom of drawing.)

### To seal or not to seal

*I just had my driveway paved. Two neighbors had theirs paved, too. All of us used different contractors. My contractor said to seal the driveway, but the others said not to seal it, as the driveway had to breathe. Who's right?*—W. Zuscin.

Since you haven't mentioned whether the driveways were paved with asphalt or concrete, here's some food for thought on both. The Asphalt Institute, Asphalt Institute Building, College Park, Md. 20740, says definitely don't seal new driveways. Since asphalt is "cut" and softened by gasoline and oil, some commercial installations—where heavy vehicular traffic can be a problem (for example, gas stations)—are sealed with a coal-tar emulsion. This sealer is applied cold 60 to 90 days after installation. Aside from this application, new asphalt is usually not sealed.

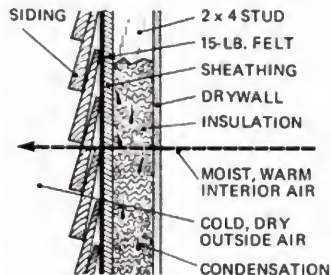
For cosmetic reasons, you may want to seal an asphalt driveway every three to five years. Most hardware stores and home centers, as well as Sears Roebuck and Co., sell coal-tar driveway sealers.

The Portland Cement Assn., 5420 Old Orchard Rd., Skokie, Ill. 60077, says that concrete driveways normally aren't sealed. However, in a very cold climate you might want to seal concrete poured in September with a diluted linseed-oil sealer. This could be brushed on in November to help prevent spalling over the first winter.

In very warm climates, a curing compound is sometimes sprayed on the concrete as soon as it is floated smooth. This retards evaporation and ensures better quality concrete.

A rule of thumb might be: Rarely seal concrete driveways. For aesthetic reasons only, seal asphalt driveways three or more years after installation.

PM



With proper insulation, inside surface of sheathing is cold. With no vapor barrier, moisture in warm air passing through interior wall condenses on sheathing and drops back into wall cavity. Vapor passing through sheathing flows outdoors.

Do you have a home maintenance or repair problem? Send it to *Homeowners' Clinic*, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get *PM's Home Care Guide*, \$4.95 postpaid. Send order(s) to *PM*, Dept. HCG, Box 1014, New York, N.Y. 10019.





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and make tracks for a nearby Metro station. Ride three stops.

## A famous ending.

Come up and then find the way to a famous ending. Continue in the most obvious direction, when you know the time is right. Before it's too late, head for the nearest bridge that can take you over water. If it becomes impossible to continue in a straight line, go toward a body of water and find a spot with three banks. From the highest bank, go in the direction of a bridge. When you've reached it, walk back 100 paces and you'll be right over the hidden treasure: a whole case of Canadian Club.

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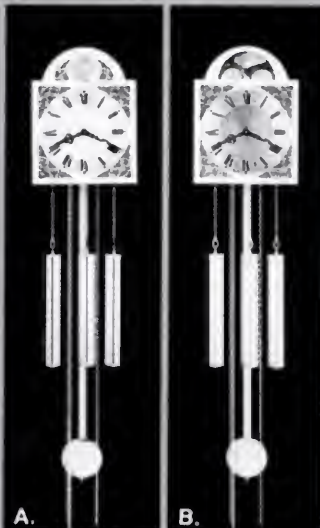
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How you drive determines how far and how often you should change your crankcase oil. It is nearly impossible to drive a car properly so that yearly changes of oil would be safe for your engine.

Traffic jams, winter warm-ups, short runs, taking kids to school, and those short trips to the store all tend to shorten the life of your oil.

On top of that, today's engines are smaller, work harder and run hotter. All of these things help foul up engine oil, create varnish, gum and sludge as they use up the additives in the motor oil.

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## Keep on pedaling, even when it snows

The story begins several years ago with too much sitting and a preoccupation with mashed potatoes, creamy gravy and other goodies. Then one day I found that my waistline was becoming a waste line, and I was in dire need of a reconditioning program.

Jogging seemed to be the natural choice for my exercise routine. However, I soon discovered several dogs in the neighborhood that were difficult, if not impossible, to outrun. I then bought a 10-speed bicycle. That was about a week before the winter of '78 wrestled the country in general—and bike riding in particular—to a near standstill.

I nearly gave up bike riding in favor of mashed potatoes and gravy. Then I decided that it shouldn't be too difficult to build a bike stand that would allow me to ride in the warmth, dryness and safety of my den.

I first cut a 5-in. section from the middle of an old aluminum chair frame at the point where the back of one's knees would be while seated. Then I fastened a corner brace on each side of the gap with metal screws and drilled a hole in each angle to line up with unused fender-mount holes in the bike frame.

The wooden supports were next cut from scrap pieces of 2x2. All four ends of these were notched to fit the diameter of the aluminum tubing. The wood braces were attached with 2½-in. corner braces at the ends.

The bike is held in place (and off



Bike exercise stand uses aluminum chair frame partially folded with back on floor.

the floor) by putting the rear-axle ends into the hollow frame and then fastening the predrilled corner braces to the bike with one bolt on each side. When the weather permits outdoor riding, the bike can be disconnected from the exercise stand in minutes.

I tried several methods to create adjustable pedaling resistance. The easiest and most effective way is to loosen the caliper-brake adjusting nut and place a 3- or 4-in. square of old bath towel between each caliper and the wheel rim. Then adjust for tension by turning the brake adjuster in and out. This method won't wear the brake pads; the toweling lasts a long time and is easy to replace.—Robert Miller



Here's what you need to build your exercise stand:

- 1 A discarded aluminum lawn chair.
- 2 Six 2½ × 2½-in. corner braces.
- 3 Two lengths of wood, 1½ × 1½ in.
- 4 Ends notched to accept aluminum tubing.
- 5 Eight No. 8 × 1¼-in. wood screws.
- 6 Twelve No. 8 × ¾-in. panhead sheet-metal screws.
- 7 Two ⅜-in. bolts to hold axle.



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# PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

## Catalog for energy savers

I am sure that many energy-conscious PM readers will be interested in a catalog now offered by the Solar Hardware Supply Co., 2160 Clay St., Denver, Colo. 80211. Titled *Household Conservation Catalog*, the booklet lists a diverse line of passive solar and energy-conservation products designed to lower home utility costs. Some of the categories covered are sealing up cracks, hot-water savers, and a current energy book list. The \$1 charge for the booklet is refunded with first purchase.—H.W.

## Crank-type fire starter

This 20th-century "bellows" delivers a flow of air exactly where it's needed to get fires going in jig time. Besides being useful at the hearth, it's a handy tool for starting barbecue fires—and it eliminates liquid starters, which often leave an "af-



Called Firefly, this fire starter is useful for fireplace and barbecue.

tertaste." Called Firefly, the tool weighs just 11 ounces. To use it, you simply point Firefly where air is needed and crank the handle. It's \$6.95, including postage, from Holiday Camping Products of Alabama, Box A, Brent, Ala. 35034.—H.W.

## Powerful puncher

This hand punch develops a ton of punching power, says its maker. This means you can punch round holes in up to 14-ga. mild steel, as well as plastic, aluminum and the like, using one hand. All of the main parts are drop-forged and heat-treated. The tool comes with a side gauge for depth adjustment; throat depth is 2 in. The Model 8500 kit includes seven punches and dies ( $\frac{3}{32}$ ,



The punch kit includes seven punches and dies and a metal storage case with a rack.



Punch is well balanced and can be used with one hand by most do-it-yourselfers.

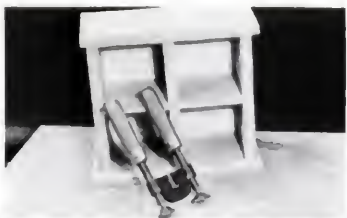
$\frac{1}{8}$ ,  $\frac{3}{32}$ ,  $\frac{7}{16}$ ,  $\frac{7}{32}$ ,  $\frac{1}{4}$ ,  $\frac{9}{32}$  in.) and a case for \$29.95.

For buying information, write Lustre Line Products, Richmond and Norris Sts., Philadelphia, Pa. 19125.—H.W.

## Special-purpose clamps

It borders on understatement to say that a workshopper never seems to have enough clamps. I spotted these clamps recently and a pair now adorn my clamp rack. Called cross clamps, they are super-handly for side-gluing operations such as applying a self edge to a countertop.

For that job, use the clamp with



Strange-looking clamp is a blessing when those special two-way clamp jobs come up.



Here, clamp held by bar clamp gripping box is used to hold the drawer bottom in.

either a short bar or C-clamp. The Model 99A is \$7.80 from Wetzler Clamp Co. Inc., 43-15 11th St., Long Island City, N.Y. 11101.—H.W.

## Family of sabre blades

Lenox-Hackmaster blade kits for sabre saws not only identify and explain the use for each blade, but also feature top-quality, long-lasting blades. The blades have a heat-treated, steel cutting edge that's reinforced with an electron-beam-welded, spring-steel spine. At hard-



Blade descriptions on pouch let you choose the right blade. Six-tooth blade is used to cut fence picket (right).

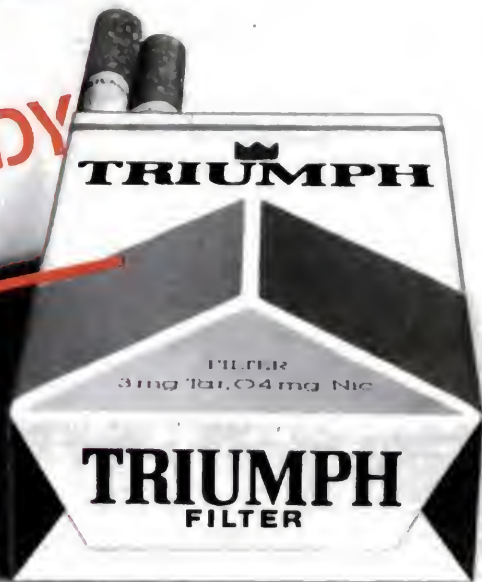


ware outlets, they're \$7 for a five-blade assortment, \$4.50 for a three-blade kit. American Saw and Manufacturing Co., Box 504, East Longmeadow, Mass. 01028.—J.P.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



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3 mg. "tar," 0.4 mg. nicotine av. per cigarette, FTC Report Jan. 1980.

# Thousands across nation using Ohio man's sure-fire way to get rich quick

Are you an 8 hour a day working person? Do you have little or no savings in the bank? Are you in debt with mortgage, car payments and check accounts? Do you have little experience at anything except the small specialty of your job?

If you've answered "yes" to all these questions, you are a prime candidate for a foolproof get rich quick system developed by a working man from Canton, Ohio. His name is Benjamin Swarez and he was in your exact same position not long ago. But, he changed all that by inventing a get rich quick system designed especially for the working man.

How did this system come about? You probably already know about Mr. Swarez and his system. Ads on his system and stories about Mr. Swarez have appeared in nearly every major newspaper and magazine in the country. Thousands of people across the nation have purchased the system and the stacks of letters from satisfied customers received by Mr. Swarez are overwhelming.

Mr. Swarez did not develop his system overnight. But his final, perfected version certainly does generate income overnight.

Mr. Swarez's first successful system netted him \$80,000 clear. What's it like to get \$80,000 almost overnight in one lump sum?

"It's almost impossible to verbalize. My wife and I just stared at the check for a long time. We had a two day celebration with a dinner and party. Then I went into work and told my smug boss, who thought he had me under his thumb, where he could stick his low paying, lousy job. Next we paid off all our bills including our house mortgage and had a burn-the-mortgage party."

The following day we went to an auto dealer's showroom and laid down cash for a new luxury car. I never had the experience of a new car even as a child."

"Then my wife and I went on a shopping spree for clothes. We had been making do with old clothes for so long they had become worn out. She always had to shop for clothes with very little money. I always joked with her that 'If I gave you \$5,000 to spend on clothes could you do it in one day?' She used to say 'I could do it in a couple hours.' So that's what I did. I gave her \$5,000 to go out and buy clothes. It ended up taking all day and she said she relished every minute."

"Finally, we took a long trip. In New York I bought her a large diamond at Tiffany's — another thing we always dreamed about."

"But I can tell you that the money was not the most important benefit in this. What money really does is give you precious time. Time to be with your wife and children before they grow up before you know it — and time to do things you really want to do. Another priceless thing you gain is your self respect. No more crawling and kneeling because you're dependent. The words of Frank Sinatra's song 'My Way' says it all."



Benjamin Swarez

How much money can you make and how fast can you make it? Mr. Swarez averages around \$200,000 for each system he produces. He says doing a system to make \$10,000 or \$20,000 is literally duck soup. "I

have these available to me all the time and don't even use them," he says.

How fast can you make money? Mr. Swarez stated, "You can actually make money within hours in some cases. You can compile a system in one afternoon one day and start having spendable money in your hands produced by the system the very next morning."

Who all can do it and how sure fire is it? Mr. Swarez says, "I've done it 14 times in a row now. I taught my younger brother and brother-in-law the system and they've already made over \$500,000 each. All you need is the ability to follow simple directions, common sense, and the ability to see a job through to completion."

This system is also perfect for people who are confined to homes, such as housewives. Mr. Swarez named his system "7 Steps to Freedom". He has been selling his system to others for a year now. The reason? "Why not?" he says. "First I thought I'd have to keep it secret. But then I found out the system can't be saturated, so why not sell it and make money by selling the system on top of the other money I am making using it."

People from every state in the union have purchased Mr. Swarez's system. What do these people have to say? Here are just a few comments:

"... It is such an excellent product that anyone who can read and follow instructions can be a millionaire. ... — William J. Bontrager, Peoria, IL

"... This is the first time I have purchased a 'get rich' product that I sincerely feel will work. ... — Earl J. Davis, Chicago, IL

"... Adjectives alone cannot describe its hidden wealth. After many years, much money and a bellyfull of frustration, I believe I have found an honest man, and yes I truly mean it. ... — John T. Vaughn, Norridge, ME

"I have just received your system and have taken it to college. It has really lifted some eyebrows especially the first and last parts. ... — Mark Kimble, Rockhill, SC

A word to the doubting Thomases. Of course there will be those who will doubt that the system is for real. Mr. Swarez has featured this system in nearly every newspaper in the country and he has sold his system to thousands of people across the nation and in every state of the union. The story has been checked repeatedly by newspaper reporters and government authorities at literally every level. The story checks out. Every word he has stated about his system is true or he would've been out of business long ago.

You can make \$100,000 in a matter of weeks or days. In some cases money starts in hours. Here's how it works...

**1** You will receive Mr. Swarez's system in the mail which contains everything you need to complete one of your own systems. From anywhere, such as your kitchen table, you complete the preliminary steps. This involves filling out provided forms and following provided outlines.

**2** The preliminary steps of the system are done only one time. After these preliminary steps, you can do the steps for each individual system anywhere, from your home, while you are traveling. (Mr. Swarez does his individual systems in his motorhome) or from a favorite vacation spot. Again, by following outlines and filling out forms, you complete your individual system (each of which is in two parts, Part A and Part B).

**3** After completing Part A and Part B of the System, depending on the type of system you do, you may either phone in Parts A and B of your individual system, or you drop it in the mail. In the type of systems where you phone in Parts A and B, you can virtually complete a system one afternoon and have spendable money in your hands the very next morning.

**4** In a matter of days or weeks, depending upon which system you do, you can receive \$100,000 for each system. In some cases, over 80% of the money will be in your possession in less than a week. Your money will either be deposited in your bank account or brought to you by mail to your home or your vacation spot.

For those who wish to purchase the N.P.G.S. System, called "7 STEPS TO FREEDOM", it is being distributed by mail only for the present. Mr. Swarez has kept the price of the system low so those who most need it can afford it.

To order: (1.) Get a blank piece of paper (2.) At the top of the paper, print the words "7 Steps to Freedom" (3.) Print your name and address (4.) Mail this along with \$20.00 in cash, check or money order to Quality Consumer; Dept. G-191; 706 Twelfth St. N.W.; Canton, Ohio 44703.

Or, if you want us to start processing your order immediately, phone in your order as follows: (1.) Dial this TOLL FREE number, 1-800-321-0888 (Ohio residents dial 1-800-362-0636) and ask for operator G-191

(2.) Say the words "7 Steps to Freedom, N.P.G.S. system" (3.) Give your name and address (4.) Give the operator one of your following credit card numbers: Master Charge or Visa (also include your Interbank number). Or, if you don't want to use a credit card, tell the operator you want it mailed C.O.D. Operators are on duty right now and around the clock.

Direct any inquiries to (216) 452-0868. Please do not dial the toll free number for information. The operators are not permitted or qualified to answer questions.



# PM BRIEFS



## PM's Whatsit

If you think the answer to this edition of our monthly guessing game is "giant frogman," give yourself an F. With your wits—and your nautical nostalgia antennae—about you, you can probably deduce exactly what this scene is all about.



## ...And he's not going to take it anymore

*Milwaukeean Ted Malnick had this problem. It seemed like every time he parked his car on the street somewhere he'd come back and find another scratch here, a new dent there. You know the feeling? So Ted took his 1970 Ford off the road and began rebuilding it—with a vengeance (plus reinforced, galvanized steel). After six months' work, he put it back on the street and felt much better about the whole thing.*

*But it sure gives us part-time pedestrians weak knees just looking at it.*

## Putting heat on the engines



One of the key points in the remarkably aggressive public relations program of McDonnell-Douglas to strip the public image of its DC-10 airliner from any special stigma uses in-flight engine shutdowns as a criterion of airliner reliability. In a recently issued information booklet on the DC-10, the company reiterates ultimate findings of the Federal Aviation Agency investigation into the causes of the American Airlines crash in Chicago in May 1979 as refutation of any alleged design problems. It then points out that DC-10s flying then and now experience significantly fewer in-flight engine shutdowns than the other U.S.-built wide-cabin airliners, the Boeing 747 and the Lockheed L-1011.

Anyone has a right to use FAA statistics on in-flight shutdowns to attempt to make a point. Engines are frequently shut down, mainly as a result of turbine blade damage from fatigue or ingestion of foreign material, on scheduled flights without the passengers aboard being any the wiser.

But apart from the fact that none of the major aircraft manufacturers actually designs or builds the powerplants its planes fly on, the use of these statistics per se begs a further question: Shouldn't they be weighted? Shouldn't a plane with three—or two—engines be expected to have a better in-flight shutdown record than one, say, with four?

In fact, such expectations are already operational, for example in the case of the Airbus A-300. While its motives were understandable, McDonnell-Douglas did not exactly gladden the hearts of its industry peers with the bit emphasizing engine shutdowns.

As a sidelight, one of the most reassuring case histories on the DC-10 will never be publicized. Earlier this year, one Eastern European airline's 10 had some engine trouble while still in home airspace. For some reason, the captain continued the flight after shutting the bad mill down, and actually flew transatlantic entirely on two. Whoops.

## Star trick

A recent issue of the newsletter of the Center for Astrophysics, operated jointly by the Harvard and Smithsonian observatories, departed briefly from reportage on phenomena and those brilliant enough to discuss them to illuminate a celestial scam.

At least two operations, one in Tarzana, Calif., and the other in Toronto, have been running advertisements offering to register individual names as the official names for the hundreds of thousands of "yet unnamed" stars listed in the Smithsonian

Astrophysical Observatory's catalog. The registration fee: a mere \$25 in both cases. What price immortality.

There are thousands of unnamed stars. And they will stay that way. In addition to the major stars, sometimes familiarly referred to by their (mostly Arabic) traditional names, all observed heavenly bodies are officially designated by numbers derived from the coordinates that provide astronomers with an "address" in the sky. The official designations are decided by the International Astronomical Union, which does not recognize individuals' names, no matter where "registered" or for whatever fee.

## Whatsit revealed

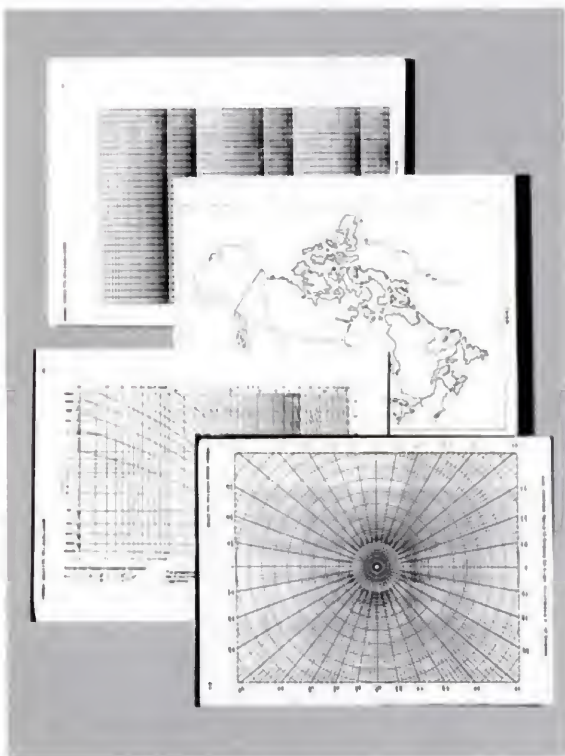
According to the British producers of the recently released film, *Raise the Titanic*, they spared no expense in constructing a 55-foot scale model that reproduces exact exterior details of the ill-fated original. Note that the movie people assume only one stack to have been blown off by the immense, final boiler explosion recalled by survivors of the April 14, 1912, disaster. Ongoing efforts by Texan Jack Grimm to locate and photograph the real sunken Titanic may revise that impression.

## It's a bird...it's a plane

Ornithopters—machines approximating the flapping-wing flight of birds—have fascinated men for centuries. If you're still fascinated and want to build an exemplary version you can—thanks to Texan Walt Kulzer. Kulzer's rubber-band-powered ornithopter set a documented flight record for models in its class earlier this year, cruising around for 2 minutes, 14 seconds inside a gym after 500 turns were wound onto the ol' powerplant. Kulzer says you can build it from about \$2 worth of balsa and paper. Complete plans for his design are \$6 from AE Products, Box 18722, Fort Worth, Tex. 76118.



## Non-book of the year



"Instant" graph paper from our Xerox machine.

Of all the schemes intended to take advantage of modern duplication technology—barring the illegal—few have the potential of a 232-page softcover volume entitled *Graph Paper from your Copier* (HP Books, Box 5367, Tucson, Ariz. 85703). While the title is self-explanatory, John Craver, the work's "author," has put more than a few easily duplicated grids into it. There are logarithmic plots, polar coordinates, probability grids and even maps—plus an introductory section on plotting and illustrating data in graph form.

There are flaws: Some of the finer grids are not quite resolved on the printed page and will deteriorate even more when copied on most machines; the book's binding must be broken down to get sheets in the center sections absolutely flat—distortion-free—on the copier plate, and the maps are obvious rough tracings. (The one of Canada, in fact, is missing an entire province—Prince Edward Island.)

Yet it is hard to see how a great many individuals with access to copiers could fail to justify spending \$12.95 for the book, with the expectation of never spending another cent for graph paper.



# TIME CONTROL

Now, a new computer development lets you control and time your entire home even when you're 1,000 miles away!

Attractive wood-grain unit adds to any decor and will Time Control your entire home. Measures 5 1/4" x 5 1/4" x 3 1/8"

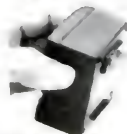


In the fall of 1978, an English company, BSR Electronics introduced a remarkable new product, the X-10 Space Controller. The X-10 allowed you to page up to 16 appliances and lights throughout your house remotely from any location. It was an instant success and rightly so. But the most vital part of the system was still in development. Not any more — with Time Control — the system is complete.

Now you can turn your lights or appliances on and off anytime, even when you're on vacation. It can program your TV or radio to wake you and start your coffee all before you get out of bed every day. These are just a few of many things that Time Control does to increase your security and convenience. It can do much more!

## IT'S REALLY QUITE SIMPLE

BSR's X-10 Space Controller is really quite simple. It's made up of a central transmitter and receivers, all of which are plugged into your 110 volt wall sockets. You press a number on the calculator-type keyboard of the central control and an electronic signal is transmitted through your existing house wiring to remote modules in which lamps and appliances are plugged.



Simple plug-in modules. No wiring required. Operates over existing in-house wiring.

Outside or overhead lights are controlled by installing a wall switch module that also receives commands from the central controller. Each remote module has a numbered thumb dial. The digital controller activates only those modules set to the desired number. You can control one or up to 16 modules with the system. Time Control adds the missing dimension to Space Control.

## NOW THERE IS TIME CONTROL

Time Control consists of a computer memory and digital clock. You can now program the exact time you want a light or appliance to turn on or off. One mode allows you to even produce a random pattern automatically to make your home appear occupied when you're away.

## SPACE AGE ROBOT

Time Control is your own space age robot with four-in-one modes for up to 16 separate functions in your home. Time Control will add conveniences and it may save you thousands of dollars when you're not at home.

• **Security Mode** is used primarily when you're away either one day or the entire summer. Selected lights and appliances

are sequenced on and off to give that lived-in appearance. First, a light in one room and then another, a radio in a third, plus the den TV, all can be programmed to fool any would-be burglar "casing" your home. You just select the lights or appliances and the times you want each to be on. Time Control can be programmed in minutes using the calculator type keyboard. One avoided robbery and Time Control pays for itself many fold. Think of the increased peace of mind.



easy to program Time Control keyboard times lamps, appliances and even outside or overhead lights.

• **Daily Timer** Select any one or all of 8 modules to time daily, then set in any time you want each to turn on and then off. Program your TV or radio to come on to wake you each morning. Turn the outside lights on at 7:00 p.m. and off at 6:30 a.m. Timed to the exact minute of each day automatically. Turn your coffee pot on each morning and shower while your coffee is brewing. Your life may never be the same again.

• **Quartz Clock** Digital Quartz accuracy in an attractive wood-grain finish. Attractive enough to add to the decor of any room. Accuracy unsurpassed by expensive chronometers costing \$200 or more. With large easy to read green numbers. May be worth the price of the unit for this feature alone.

• **Panic Button** This bonus feature allows you to turn on all of your lights from your bedside to frighten away peeping toms or intruders. Further peace of mind when you're away and your spouse is home alone.

## NO WIRES NEEDED

One of the nice features of time control is that no wires are required. All appliances and lamp modules simply plug into your wall sockets. For outside or overhead light control, you merely change your existing light switch with BSR's wall switch module. Time Control takes it from there.

## BUILD YOUR OWN PERSONAL SYSTEM

If you already have a BSR X-10 Space Controller, all you may need is the timer at \$74.99. If not, we recommend a starter kit at \$119.95 consisting of the timer, two lamp modules and one appliance module. You save \$6. We sell all BSR X-10 Accessories so you can add additional modules as you need them to Time Control your entire home.

## 30 DAY NO-RISK TRIAL

Test the Time Control for 30 days at no risk. If Time Control does not provide the convenience and peace of mind we say it can, or for any reason, return it to us. We will promptly refund your purchase price. What have you got to lose?

## WARRANTED FOR ONE FULL YEAR

Time Control is an all solid state unit. It should provide you with many years of trouble-free service. If in the unlikely event anything should go wrong during one full year, it is factory warranted by a sizable company, BSR.

## HURRY! QUANTITIES ARE LIMITED

When we were given the opportunity to introduce Time Control in this country, we jumped at the chance. We also knew quantities would be limited this year. BSR has set aside quantities of Time Controls for us. But there may not be enough. So to be assured of being one of the first to get your Time Control—Don't wait, order now!

## TO ORDER your Time Control

Simply fill out the coupon and send it along with check or money order to the address below. For even faster service credit card customers can call: Toll Free 1-800-527-7066; in Texas call collect: 1-214-349-3120

## MEDIA MARKETING

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- **YES!** Send me \_\_\_\_\_ Timer(s) only at \$74.99, add \$2.50 shipping, handling & insurance.
- **Save \$6.00.** Send me \_\_\_\_\_ Time Control Kit(s) at \$119.95 (includes 1 timer, 2 lamp, and 1 appliance module). Add \$3.50 shipping, handling & insurance.
- Send me the following modules. Add \$1.00 shipping & handling.

\_\_\_\_\_ Lamp Modules at \$15.99

\_\_\_\_\_ Appliance Modules at \$15.99

\_\_\_\_\_ Wall Switch Module at \$17.99

Texas residents add 5% sales tax.

**Ask for other BSR X-10 Accessory Prices**

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☐ Check or money order enclosed.

☐ Charge to: ☐ Mastercharge ☐ Visa

Acct. # \_\_\_\_\_

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1. Irwin Speedbor "88" wood bit for all electric drills. Spade-type head, original hollow ground point starts and cuts clean and fast in any wood, 1/2" to 1 1/2". Available individually or in workshop sets.
2. Irwin No. 22 "Micro-Dial" hand brace expansive bit bores 35 standard holes 1/8" to 3". Just dial the size you need. No. 21 bores 19 standard holes, 1/8" to 1 1/4".
3. Irwin 627 Solid Center hand brace bit delivers double-flute boring action. Medium-fast screw pitch. Balanced cutting head, 18 sizes, 1/8" to 1 1/2". Available individually or in sets.



You can easily bore holes up to 1 1/2" with the Irwin Speedbor "88." This is the wood bit that cuts clean, fast, accurately. Puts more boring power at the working end of your 1/4" electric drill.

Irwin's exclusive hollow ground point has the power to start holes fast. Sharp spade-type cutters power through any kind of wood. 1/4" shank chucks perfectly.

#### Workshop special

Set of 6 Speedbor "88" bits with metal hang-up rack. Sizes 1/8", 1/4", 3/8", 1/2", 3/4", 1".

#### Irwin Screw Starter

Marks hole, starts hole, threads hole for screw to easily enter wood and non-metal materials. Handiest hand tool in years for housewife and handyman.

All items above are available in metric sizes.



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# IMPORTS & MOTORSPORTS

## Showing its stripes



The Lancia Scorpion is  
challenging Porsche  
for the 1980 Makes  
Championship.

Vincenzo Lancia, founder of the Fabbbrica Automobili Lancia in 1906, would be proud: His cars were winning races in the United States in the years before World War I, so he knew firsthand the thrill of watching his own racers take the checkered flag. This year, in the manufacturers' competition, formally known as the World Championship of Makes, Lancia is out in front, which is an upset for the long-dominant Porsches.

At Watkins Glen in July, Lancia stretched its lead when its turbo-charged Scorpions finished 1-2. If all goes well for the Group 5 cars, they'll have the title in the bag before the last event, the 1000 km of Dijon (France), which runs Sept. 28. The Scorpions compete in the under-two-liter class with their four-cylinder engines which displace 1425 cc. Why so much under two liters? Because when you apply the 1.4 handicap factor that affects turbo engines in the series, you get  $1.4 \times 1425$  cc, or 1995 cc—just a couple of cubic centimeters under the limit.

Lancia sports and GT models for the street are powered by full two-liter engines, as are Fiat's Brava and Spider 2000 models. Lancia, of course, is a division of Fiat Motors of North America. The two-liter, four-cylinder Fiats don't get 400 hp at 8800 rpm like the Scorpions, but they do get a nice hp boost now that you can get them with optional fuel injection. The Bosch L-Jetronic system adds 16 hp, giving both cars a rating of 102 hp at 5500 rpm. Still,



Fiat Brava now offers fuel-injected Four.

EPA mileage of the Brava is a respectable 24 city and 34 highway; the Spider is 25 city and 36 highway. Thrifty-quick cars, I call 'em.

## A cool 2418 mpg

And what did you do on your summer vacation? In Germany, an entrant in the Kilometer Marathon set a new world fuel-economy record. A 200-cc, single-cylinder diesel and one liter of fuel whisked the winner along at 13 mph on the kilometer course for an equivalent 2418 mpg. "The 'Unterturkheim 1' fits like a wetsuit," exclaimed driver Volker Schramm of the three-wheeler. This



Fuel-economy champ Unterturkheim 1 is at top, second-place Silver Arrow, above.

year's mileage topped the 2281.8 mpg set last year (see *Imports & Motorsports*, page 66D, Dec. '79), also by a team from Mercedes-Benz.

Nowhere near as economical as the winner were two "Silver Arrows," designed and built by apprentices at the Mercedes plant in Sindelfingen. They achieved "only" 2041 and 1481 mpg to finish second and third, but they got most of the attention because of their fascinating and futuristic shape.

The mileage contest is held at the Hockenheim Motordrome near Stuttgart, Germany, and is sponsored by the Shell Oil Co. and *Auto, Motor and Sport*, the German car magazine.

The Unterturkheim 1 uses 27-inch



bicycle wheels with covered spokes to carry its synthetic foil body. The chain-driven vehicle weighs in at 111 pounds, and, I suspect, the winning driver didn't weigh much more.

#### Isuzus are coming

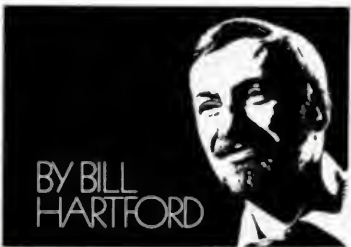
Early next year there will be another Japanese car on the market. Isuzu, who brings us LUV pickups through GM dealers, will enlist its own dealer network to market a line of passenger cars and lightweight pickup trucks.

Sedans, coupes and pickups—19 models in all—will come with either gas or diesel Fours. American Isuzu Motors Inc. (AIMI) expects 75 percent of the anticipated 20,000 first-year vehicle sales to be diesel. PM will have more on the Isuzus after we get behind the wheel.

#### Diesel chatter

The 600 miles I added to the 3000 already on the odometer of a Volvo diesel station wagon with automatic transmission last July were certainly economical ones: 26 mpg overall. The six-cylinder wagon is especially spirited when you're running with the trucks. Even at speed, though, a too-audible combustion "tickle" wouldn't let me forget that I was at the wheel of a diesel. I'd rather be reminded only when refueling. Two stops (in the Northeast) found fuel at \$1.15 per gallon (Arco) and \$1.19.6 (Getty). Volvo's new diesel is well suited for a relaxed, country way of life: best I could do was 15 seconds for 0 to 45 mph and 21 seconds for 0 to 60.

Once under way, however, this luxury wagon really shines: Just fill it with family and fly. And, at \$13,000 to 14,000, it is competitive: You have to consider that the little, four-cylinder diesel Rabbit will set you back \$10,000 and the five-cylinder Mercedes diesel \$25,000. Make mine a Six. **PM**



BY BILL  
HARTFORD

## Geocel runs rings around crumbly caulks.

With Geocel Caulding Sealant, you won't see your money and hard work crumble away. Because it's more flexible than any other caulk, it won't break with normal expansion and contraction. Geocel stays pliable for years, too. Look for Geocel at your hardware store or home center.

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Light. Smooth. Imported Canadian Mist.<sup>®</sup>  
The whisky that's becoming America's favorite Canadian.



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Photographed at Lake Beauvert, Jasper, Canada



# NEW NOW for home and shop

**A** The new container for Eimer's Wonder Bond Plus cyanoacrylate adhesive has several advantages, says its maker. The applicator is clog-resistant and gives controlled, one-drop application for broken glass and china repairs. The container's square shape allows it to stand upright for handier use and easier storage. The clear adhesive bonds in seconds and is recommended for use on nonporous materials such as steel, glass, many plastics, aluminum and ceramics. A three-gram bottle costs about \$2.60 from Borden Chemical, 180 East Broad St., Columbus, Ohio 43215.

**B** This bandsaw with 18-in.-dia. wheels and a 1-hp motor cuts metals, plastics and wood at a blade speed of up to 3500 feet per minute. The one-piece, welded-steel frame has upper and lower doors for quick blade change. The blade guides have upper and lower backup ball bearings. The saw (\$1600) has an 18×20-in. table and foot-operated brake. It takes 23×32 in. of floor space, and is 6 ft., 2½ in. high. Blade-throat capacity is 17¼ in.; cutting-depth capacity is 12 in. Parks Woodworking Machine Co., 1501 Knowlton St., Cincinnati, Ohio 45223, makes it.

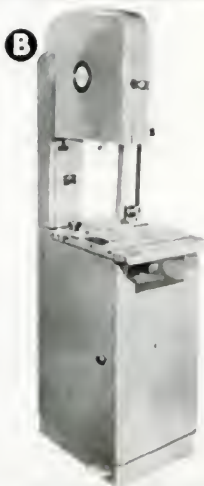
**C** The scenic pattern of this vinyl shower curtain from the Wall-Tex MatchMakers collection complements the wall covering shown, which is called "I Saw a Ship a Sailing." There are five other designs: three florals, an old-time eau de cologne motif, and a romantic art nouveau motif. Each design is available in several color combinations to coordinate with a wall covering. The shower curtains are 72×72 in. and are priced at \$25. The wall covering ranges from \$9 to \$17 per roll depending on the pattern. Companion fabric in the ship motif is also available from Columbus Coated Fabrics, Div. of Borden Chemical Inc., Columbus, Ohio 43216.



**A**

**D** You can make fast, accurate, tight-fitting miter cuts with your circular saw and the Miter Maker, according to its manufacturer. Set one of the aluminum fences from 0 to 90° on the calibrated scale, hold the workpiece against the fence, lower the saw and make the cut. Among the miter cuts the tool lets you make are: straight, octagon, hexagon, picture frame and door/window frame. Compact and portable, the Miter Maker will accept most circular saws with 7- to 8¼-in.-dia. blades. The unit has a molded-plastic base and rests on nonslip feet on a workbench or countertop; or you can use wood screws to mount it permanently. Miter Maker (\$40) is available from the Hirsh Corp., 8051 North Central Park Ave., Skokie, Ill. 60076.

**B**



**C**



**D**





# NOW, For The First Time- Use The WOODBITS The PROS Use!

PROFESSIONAL WOODBITS are NOT available in hardware stores. Stores only carry spade bits which tear grain, clog and bind; or metal-cutting twist bits that also bind and — what's worse — "skate" off the mark.

## Why is a WOODBIT Best?

A PROFESSIONAL WOODBIT has four features designed specifically for wood:

- A CENTER SPUR that locks your bit on course and so prevents "skating".
  - TWO CUTTING SPURS that start and dimension a perfectly round hole.
  - EXTREMELY SHARP FLUTES extend from the two cutting spurs and continue the cutting action all the way through the wood ... shaving the sides smooth. Most important, the two spurs will not splinter the wood as the bit cuts through ... as spade or metal cutting bits do.
  - THE CUTTING FLUTES ARE ENGINEERED for optimum chip ejection so that your drilling machine won't bind and burn out.
- LEICHTUNG'S PROFESSIONAL WOODBITS can be used in portable drills or drill presses with chucks of  $\frac{3}{8}$ " or more. 7 piece chrome-vanadium steel set includes  $\frac{1}{8}$ ",  $\frac{1}{16}$ ",  $\frac{1}{4}$ ",  $\frac{5}{16}$ ",  $\frac{3}{8}$ ",  $\frac{7}{16}$ " and  $\frac{1}{2}$ " sizes. Lengths from 2 $\frac{1}{4}$ " - 5 $\frac{1}{2}$ ". Made by German professionals for pros or "wood-be" pros.
- 7 PIECE WOODBIT SET ..... ONLY \$17.95**



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Primarily for use in a drill press, these larger diameter bits can be used  $\frac{1}{2}$ " BIT... \$11.95 in any powerful portable drill with a  $\frac{3}{8}$ " or larger chuck. These are  $\frac{3}{4}$ " BIT... \$13.95 really top quality professional cutting tools. The  $\frac{3}{8}$ " bit is 7 $\frac{1}{8}$ " long, the  $\frac{1}{2}$ " BIT... \$15.95  $\frac{3}{4}$ ",  $\frac{1}{2}$ " and 1" are 7 $\frac{1}{8}$ " long. No collars available. 1" BIT... \$17.95

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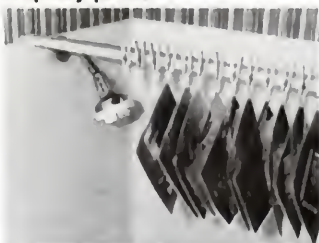
## PHOTO HINTS

### Dust blower



To get a blast of air that blows dust off negatives in the enlarger, try an inexpensive battery filler. It's big enough for one squeeze to do the job.—Robert Hertzberg

### Drip-dry prints



Resin-coated (RC) print drying can be easier if you make a drying rack from 1x2 furring strip and clothespins. Cut the strip to fit over the tile around your bathtub.—Frank H. Day

### Funnel fun

The top of a two-liter plastic soda bottle makes a good funnel. The bottom half can also be recycled and used for containing liquids, holding parts or whatever.

—Ross Brummer

### Give spots the brushoff



Minerals in the water supply can leave spots on ferrotype plates. Toothpaste mixed with a little water will scrub the spots away.

—Robert Hertzberg



# Now you can enjoy a complete home shop at a substantial savings — and in less space than it takes to store a bicycle!

You can have all the tools you need to turn out top-quality woodworking projects in a complete home workshop like those you've dreamed of owning. And you can have it within your budget... and your limited work space.

To learn how, simply mail the coupon below. You'll discover how you can be prepared for all those money-saving, moneymaking projects like doing your own home repair and remodeling jobs, even building furniture and cabinets. Shopsmith has made it easier and more affordable than you'd ever imagine.

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You can't do jobs like these without the proper tools. You know that's true if you ever tried to build anything more complicated than a birdhouse. You need more than a couple of hand-held power tools to achieve the kind of results you can be proud of.

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The MARK V gives you all five of the most needed power tools in a single, powerful, precise machine that requires about the same space it would take to store an ordinary bicycle.

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More than 350,000 people like yourself have chosen this Shopsmith multi-purpose tool as the best possible solution to budget and space problems. And it's easy to see why — the time-tested MARK V includes all five major power tools in one free-standing unit.

The easy-to-learn, easy-to-use Shopsmith woodworking system features a 10" table saw, 16½" vertical drill press, horizontal boring machine, 34" lathe and 12" disc sander. A rugged 13.5 amp motor that develops more than 2 hp provides all the power you'll need for even the toughest jobs. And, thanks to the exclusive speed dial, you can change speeds without ever shutting off the motor.



Switching tool operations couldn't be easier. After only about an hour's practice, you'll be moving from one function to another in 30 to 90 seconds.

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That's why thousands of people with unlimited budgets and more than enough space still choose the Shopsmith MARK V!

Find out why it should be your choice, too. We'll send you all the facts and also tell you how you can actually put the MARK V through its paces, in the privacy of your home, for a full month without ever risking a cent! Mail the coupon now for everything you need to know.

**The Shopsmith MARK V —  
the tool to start with...  
the system you grow with!**



The Mark V is a lathe of exceptional capacity (above) and a 10" table saw (right) with a 3/4" depth-of-cut and a 48" ripping capacity



It's a 12" disc sander that will do things that other sanders won't do...like finishing edges to precise dimensions.



It's a horizontal boring machine that makes perfect doweling really easy! The Mark V's exclusive feed stop assures identical hole depths.



It's a 16½" variable-speed drill press with built-in jiggling features that make boring screw pockets and even round stock a "snap"!



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# CAR CLINIC

## SOLUTIONS FOR MECHANICAL HEADACHES BY MORT SCHULTZ



### Start of a new day

My 1980 Oldsmobile Cutlass 350-cu.-in. diesel engine has had an alternator vibration at 47 mph since day one. The dealer's service department has replaced the bearings, shaft and bracket without success. Now I'm told this is a common problem, which is verified by several other 1980 Olds owners I know. They're having the same trouble. Is there a solution? — Richard E. Kerby, Dubois, Ind.

Yes, sir, there is. It's in the form of service bulletin 80-T-7, which is titled "Delcotron Moan: Oldsmobile-Built Engines."

The problem and solution apply to 1980 Oldsmobile diesel and gasoline engines. In 1980, Oldsmobile made a change in the alternator drive-belt system which is causing this vibration, as you call it—moan, as Oldsmobile calls it. Other manufacturers that use the '80 Olds engine aren't having the trouble, because they didn't adopt the revised drive-belt system.

According to the service bulletin, the solution to the problem is to replace a brace and pulley. All parts and instructions are contained in Retrofit Kit No. 22510310.

Since the moan is a result of an engineering design, the repair is covered by warranty although your car may exceed the warranty period. If the dealer argues about this, let the Oldsmobile zone office decide the issue.

### ESP (Easy Solution Possible)

Not long ago, the front brake pads of my Toyota Celica with ESP brake-lining-wear sensors, which "see all, know all and tell all," wore to the point where the ESP BRAKE LINING WEAR light on the dash went on. When replacing the pads, I found that one of the wear sensors (there's one placed in each inner brake pad) had rubbed against the rotor.

During normal braking, the rotor wears against the plastic sensor and cuts a loop of copper wire. When the copper wire (circuit) is broken in either sensor, the warning light flashes

on to tell the driver to replace brake pads.

These sensors are tricky. You can replace brake linings, as I did, but this doesn't turn off the light. As long as the copper wire in one or both sensors remains broken, the warning light stays on. I was told by a Toyota dealer that I have to replace the whole sensor, for \$17, to make the light go out. To which I say: Nuts! I've found a better way. It's this:

- Remove the sensor from the old brake pad and clean its surface.

- Look for two copper dots in the plastic.

- Bridge these two dots with a bead of solder.

- Cover the sensor surface with a coating of epoxy. Let epoxy dry and install sensor in the new brake pad. The warning light will go out.

When linings again wear down to a point where they have to be replaced, the rotor will rub through the epoxy and wear away the solder to break the circuit again, causing the warning light to flash. Neat, huh?—Jeff Sinez, Huntsville, Ala.

You bet. All you Toyota Celica owners with ESP brake linings ought to send Jeff a note of thanks. He saved you \$16.85—that's \$17 for a new sensor, less 15 cents for a stamp on the thank you note.

### Sealing unsealed seals

At 11,000 miles, the rear oil seal in the 2300-cc engine of my 1977 Ford

Pinto station wagon went bad. But no sweat. The repair was covered by warranty, so the seal was replaced free of charge by the dealer. Now, at 24,000 miles, the seal has gone bad again.

This time I will have to pay unless I can get proof that ruptured seals are a recurring problem with the 2300-cc engine. The dealer says it isn't. I hope you can tell me it is.—Gene Suckut, Bowdon, N.D.

Sorry, Gene, it isn't. The Ford 2300-cc engine isn't one that normally rips apart rear oil seals. However, this does not mean that you don't have a valid argument for trying to get the repair done free of charge again.

A probable reason for seal failure is improper seal installation. The seal for the 2300-cc engine is a split one (two halves). Both halves have to be dipped in lubricant before they are installed. If the seal isn't treated this way, in time it will weld itself to the journal and be ripped apart by crankshaft rotation.

The manual says you should dip the seal in fresh engine oil. A spokesman at Ford was more specific. "Saturate the seal with Lubriplate," he says.

The surfaces on which the rear bearing cap rests (that's the cap that fits over the seal) must also be treated properly in order to prevent loss of oil (maybe the seal hasn't gone bad, but oil could be leaking from around the cap). The surfaces should be clean. Then, with the seal in place, a 1/8-in. bead of RTV sealer has to be applied to the surfaces. The procedure outlined in the service manual is specific about this.

### Careful—it's not gridiron

How do I remove a decal from the inside rear windshield of a car that has an electric rear windshield defroster without destroying the defroster grids?—Joe Letterman, Hartford, Conn.

Whatever you do, don't try to

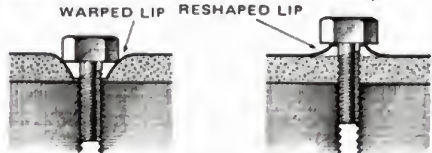
(Please turn to page 72)

### Fixing warped valve covers

Here's a neat tip we received from Rod Lasley, who's figured out a way of repairing warped and deformed bolt holes in valve covers.

Most valve-cover bolt holes get bent out of shape due to overtightening of the bolt. This tends to pull the metal downward, forming a cone effect and effectively preventing a good, solid seal between the valve cover, gasket and cylinder head.

Instead of using a shim, Rod advises us to turn the valve cover upside down and bang out the hole with the round end of a ball-peen hammer. The metal should be bent to form a cone in the opposite direction from the deformation. This cures sealing problems.





# The McCulloch 610 is a real animal.

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electronic ignition and an adjustable throttle latch, it's even an eager beaver on starts. In fact, the 610 is so easy to care for and ruggedly built, it may be the last saw you'll buy.

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Chain Brake/Hand Guard that stops a moving chain in milliseconds, significantly reducing the hazard of kickback.

Check out the Pro Mac 610 at your local dealer, hardware store or home improvement center. You'll find McCulloch listed in the Yellow Pages under "Saws."



**Sawing is believing.**

## CAR CLINIC

(Continued from page 70)

scrape or pull the decal off. You will probably cut or pull away the defroster grid wires.

There is a procedure you can try, but it has to be done with much patience and care. Let me lay it out for you, so there will be no misunderstanding.

■ Purchase an aerosol spray can of 3M Wood Grain and Stripe Remover (part No. 08907) from a dealer handling automotive parts or paint supplies.

■ Read and follow the instructions on the can. This is potent stuff, so don't try to improvise your own methods.

■ Wear rubber gloves and cover the rear deck under the windshield with a rubber drop cloth, just in case some of the remover should drip on something.

■ Using a single-edge razor blade or nail file, make horizontal cuts in the decal between the defroster grids. But be very careful. If you should nick a grid, you'll kill the defroster.

■ Spray the remover onto a cloth. Do not spray it directly on the decal because overspray might get on and

damage upholstery or plastic parts.

■ Hold the saturated cloth against the decal. Don't rub. The remover should disintegrate the decal material. If some of the decal remains, repeat the procedure.

■ After the decal has been removed; some of the adhesive coating will probably be left on the glass. To get this off, you should saturate a cloth with fingernail polish remover or rubbing alcohol and gently wipe away the adhesive without disturbing the grid. Finally, wash the glass and any surrounding surfaces that the remover might have touched with detergent and warm water to be sure everything is clean.

## Getting to the core

*In a car with carbon-core cables and conventional breaker point ignition, what causes the insulation on cables to char at the distributor end? Can this charring be prevented?—Al Mislley, Park Ridge, N.J.*

A loose fit between the cable and terminal in the distributor, so electricity has to arc the gap—that's what usually causes charring. This was a problem in older installations until manufacturers began to make components that provide a close tolerance between cables and distributor cap.

If your car is having burned-cable problems, one way to overcome the

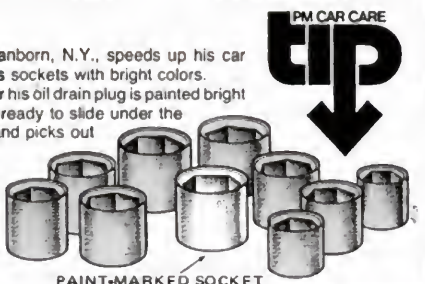
## The better to see you

Long-time reader Wayne Rivers of Sanborn, N.Y., speeds up his car maintenance by spray-painting various sockets with bright colors.

For instance, he tells us the socket for his oil drain plug is painted bright red for easy identification. When he's ready to slide under the car, he just reaches into his toolbox and picks out the correct socket—no guesswork.

Manual gearbox oil and rear-end oil also have to be changed periodically. A different color for each job should get those chores done faster.

More tips, anyone? If you've got them, we want to hear about them.



# We've Got Some News For People Who Think Our Roofing Is Just For Roofs.

Every day somewhere in America, another do-it-yourselfer finds another way to use Onduline's® new Easy-Cover™ roofing and siding. A lot of people know Easy-Cover as the most revolutionary roofing product to come along in years—but how about Easy-Cover as privacy fencing? Or patio cover?

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started. And then the free Easy-Cover installation guide shows you how to start. Your dealer has copies of both. **YOU CAN LOOK HIGH AND LOW WITHOUT FINDING A BETTER BUY THAN EASY-COVER.**

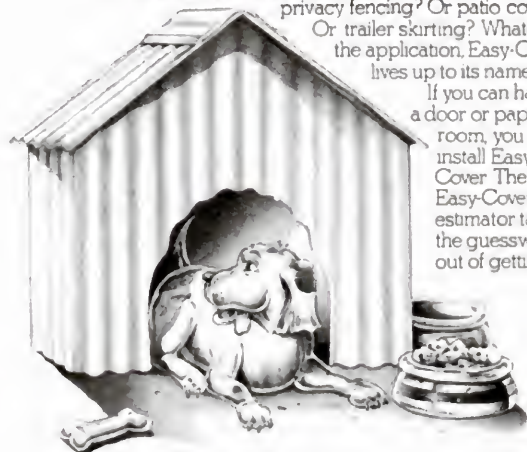
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trouble is to buy yourself a set of new cables and a new distributor cap. Work the cables into the cap just as far as they will go, squeezing the cable boots as you do this to expel air that would otherwise be trapped. Installed this way, such snug-fitting cables should go a long way to prevent charring.

## Second opinion

*What can I do about a Lean Burn with heartburn? The condition afflicts a 1977 Chrysler Cordoba 400-cu.-in. Lean Burn engine that backfires on deceleration after passing other cars? The dealer is stumped. — Donald J. Smith, Alexandria, La.*

He shouldn't be. The answer to your question is probably right in his files.

Have him begin with the ignition system. Connect a timing light. Start the engine and turn on the headlights, heater blower motor (to high) and heated rear window. If the timing mark jumps erratically, charging-system electrical interference is probably disrupting the operation of the Spark Control Computer and is giving your Lean Burn engine "indigestion."

The trouble can be resolved by re-routing the black alternator ground

wire, as explained in service bulletin 08-30-77. This rerouting is too complicated to explain here, but the diagram in the service bulletin makes this crystal clear. This job should be a freebie. It only takes a couple of minutes to do and, besides, the backfiring is a result of an original design.

If the ignition system isn't the source of backfiring, then the fuel system is the cause, and here we open up a real can of worms. Service bulletin 14-09-77 lists a whole mess of things your dealer should look for, including a vacuum leak, a weak accelerator pump, an incorrect carburetor float level, a sticking carburetor metering-rod carrier, a stuck heated-inlet air door and a faulty fuel pump.

In this case, you'll probably have to bear the cost of finding and fixing the trouble, unless you're on record as having had the backfiring condition since the time the car was under warranty.

## GOT A PROBLEM WITH YOUR CAR?

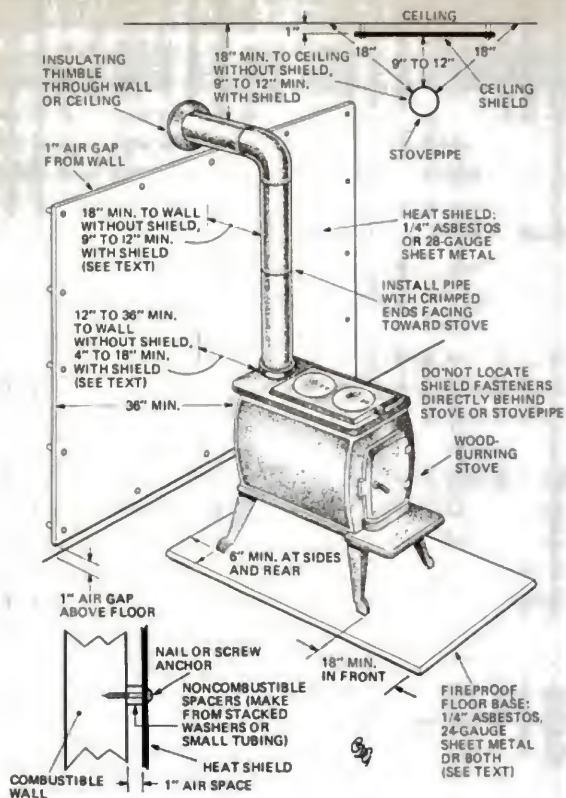
Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

## Safety and service tips

■ In need of an up-to-date directory that tells where you can get propane? You can buy one for \$3 from the National LP-Gas Assn., 1301 West 22nd St., Oak Brook, Ill. 60521. It lists places throughout the United States where propane cylinders used by RV, trailer and camper owners may be refilled, and where propane-fueled cars, trucks and motor homes may be filled. Of the 5300 places listed in the directory, 3780 are equipped to accommodate vehicles that use propane as a fuel.

■ Chrysler calls the condition "cold bucking." It describes rough engine performance during acceleration and/or deceleration of 1980 cars and trucks with automatic transmissions. The trouble occurs when engines are started in cold weather and stems from the speed at which the lockup torque converter engages and disengages. To eliminate "cold bucking," Chrysler wants you to have a new torque converter lockup spring (part No. 4202672) installed. Service bulletin 21-12-80 authorizes your dealer to do this for you free of charge.

■ If you haven't heard (maybe you bought your car used), approximately 350,000 1971-74 and 1976-77 Mercury Capris have been recalled by the Ford Motor Co. to repair a defect with the manual floor-mounted gearshift lever. The shift lever allegedly has been breaking free of the transmission, leaving drivers without the ability to shift. Take the car to a Mercury dealer and tell him to refer to Recall No. 792-269. **PM**



at left, above). Fireproof base under stove must extend 18 in. in front, 6 in. at sides and rear. Combination stove/fireplace by Jotul (above) is correctly placed against masonry wall and on masonry base with metal shield properly positioned underneath it.

Properly installed heat shield behind wood stove permits safe operation near a combustible wall, reducing normally required clearance by 50 percent or more. It should be spaced at least 1 in. from wall to allow cooling air to circulate behind it (detail, drawing

# How to keep the home fires burning...safely

Wood stoves don't cause fires—people do. Here's how to install one properly.

by John E. Gaynor

**L**ast year, 14,000 home fires were started by wood or coal stoves, according to the National Fire Protection Assn. (NFPA). More than 150 occupants lost their lives, and some 4600 were injured.

Frightening statistics? Yes, but they don't tell the real story. First, stove fires are fortunately rare compared to the number of stoves in use. Those 14,000 cases, as tragic as they were, represent only 0.2 percent of stoves installed in U.S. homes.

More importantly, studies by the NFPA and other consumer-safety agencies all indicate that most stove-related fires actually result from improper installation or careless use, *not* faulty equipment. In other words, stoves themselves do not cause fires—people do.

A properly installed stove is as safe as your furnace. Follow these simple rules and you can relax and enjoy the cheery warmth of a wood fire—confident that the fire will stay where it belongs.

The best location for a wood stove is in a fairly large, open area. Most bedrooms and dens are too small and cluttered to make good use of the considerable heat a stove generates, and safe use could be a problem. Such areas are better warmed by

smaller gas, oil, electric or kerosene heaters (see *Space Heaters: How to Choose from 31 Types*, page 102).

## Why a fire can happen

Don't be lulled into a false sense of security because your walls are of noncombustible plaster or plaster-board. The fact that the plaster itself can't burn is not the point. The real danger lies in a curious and little-known characteristic of wood: When it's subjected even to moderate heat over a long period, its normal flash point (ignition temperature) of 700° F. can be drastically lowered—some researchers think to as little as 200° F.—less than the boiling point of water!

"Wood studs, even though covered

(Please turn to page 76)



# PHONE WIZARD

**DICTOGRAPH®** the producer of communication systems for the White House and Pentagon, introduces a space age computer phone. An amazing futuristic instrument capable of 25 functions and memory bank storage of 30 numbers — convenient compact size — all at a price that will make you smile!

No one's got it. And if they do, it's twice the size and triple the price. The Phone Wizard is lightweight (only 15 oz.) and compact, measuring only 8 1/4" x 6" x 1 1/2". The Phone Wizard was selected as the "Most Innovative Electronic Product of the Year" at the recent 1980 International Consumer Electronic Show. All American made, it is approved by the FCC (U.S. Government).

The Phone Wizard is based on a unique 'Logical Language Sequence', which gives each key multiple use. This feature is activated by pressing a predetermined code onto a multiple use key (like a multi-function digital watch).

## It's an Automatic Dialer

Think of the number of people you frequently call. The Phone Wizard stores up to 30 often used phone numbers (up to sixteen digits each) in its Memory Bank.

When dialing don't pick up the phone, just push the right button and listen. The built in loud speaker lets you hear the other person answer or the busy signal.

Glance at the big bright LED display. You'll immediately know the right number is being dialed—

## More Outstanding Features

- Pressure sensitive keys, solid face (no buttons).
- Beep tones tell you that each digit is being dialed or stored correctly.
- Back-Space Erase lets you 'erase' a wrong number. Easy as pie.
- Want to confirm a stored number? Just press the storage button twice. Instantly you'll see a big read-out so you can verify.
- Automatically rings your number up to six times, then stops when your party isn't home.

## Connects to Any Phone System In Minutes

**MODULAR PLUG SYSTEMS.** Installing the Phone Wizard to any modular plug takes only minutes. Simply unplug line from phone and plug into connection labeled "line". Then plug one end of Phone Wizard cord (included) into connection marked "phone" and the other end back into telephone. Even older platforms require only an inexpensive adapter. This adapter is available at any stereo/radio store and connects in seconds. In addition, Phone Wizard automatically transforms dialer phones to

push button.

**INTERNAL PHONE SYSTEMS** sometimes require the dialing of 1 or 2 digit excess number to connect with the main system, for recording reasons. With Phone Wizard, you can still store frequently used numbers, and still press only one key for dialing. For example, the excess number is 91. Just press 91. Then press Pause, which allows enough time for internal recording. Then continue pressing the number desired, say 265-829-2112. The LED will display 91P2658292112. Now press Store/Reset and the desired storage position. Instantly, the number is stored for "one-touch" dialing.

**PRIVATE PHONE COMPANIES** such as SPRINT or MCI are easily used with Phone Wizard. The only difference is that you'll use two memory keys. The first stores the computer access number, for instance, 492-5000. The second stores your authorization number, plus the full number you want memorized. To place the call, press the first key (storing access number), wait for the computer's signal. Then rapidly press the second key TWO times. Now your call is automatically placed.

**MULTI-LINE** phone systems require an adapter, which is quickly installed. Up to 5 lines can be hooked into the adapter. Or you can connect other phone accessories. Ordering instructions follow.

## Busy Number Buster and Emergency Dialer

Suppose the number you're calling is busy, just touch the Re-Dial Key, to recall. Still busy? Just program the Phone Wizard to redial later on (up to 15 times, one per minute). A special sign on the display will indicate that the number is being redialed.

**Emergency!** Here's the quickest and easiest mechanism for dialing the Police or Fire Dept.

## Conference Speaker For Group Conversations

Activate the One-Way Conference Speaker by depressing a button. Conduct group meetings over the phone. Everyone on your end will hear the phone conversation through Phone Wizard's loudspeaker. You relay ideas and suggestions from the group by speaking through the telephone receiver, and everyone hears the answer. Meet by phone, you'll save time, effort, and not

This incredible phone dialer lets you regulate outgoing phone calls using a secret lock command.



to mention those high gas bills.

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Time of day displayed in hours, minutes and seconds.

**Stop Watch Feature** times all calls automatically—great for gauging long-distance calls, keeping records, cutting down on expenses by limiting calls, etc.

You can even time a particular PART of a call. That's how exact this special feature is.

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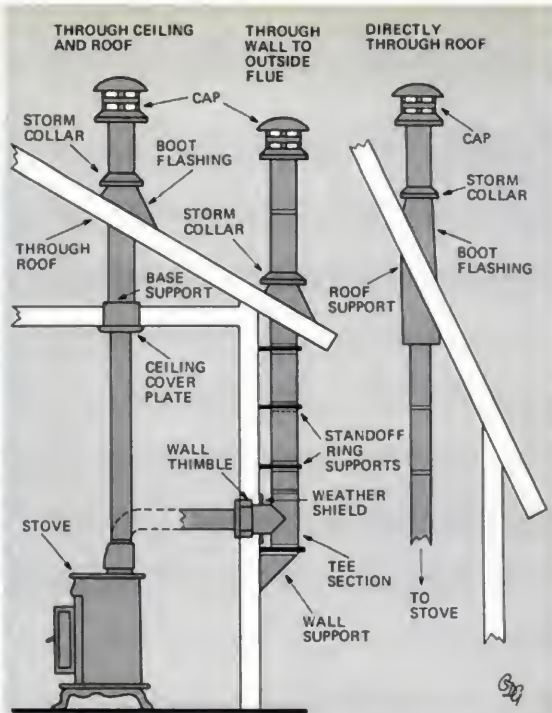
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Aftermath of a stove fire that didn't have to happen: Photo dramatically illustrates how poorly installed heater, with no shield behind or under it, led to tragedy. Drawing at right shows three ways to vent a stove to the outside. Ordinary stovepipe can be used only for short run from stove to nearest wall or ceiling. Beyond that point, you need approved prefab chimney flue.



## BURN HOME FIRES SAFELY

(Continued from page 74)

by noncombustible plasterboard, can burn at abnormally low temperatures if exposed to constant heat from a wood stove," says the Engineering Experiment Station of the Georgia Institute of Technology. The same is true of floor joists, even when under brick, slate or tile.

This is why it is essential to maintain the recommended clearances around a stove and its flue. The clearances given here were established by the NFPA. However, they are *minimums*. If a particular stove maker recommends a greater clearance, heed his advice. Freestanding fireplaces give off less heat than a stove and usually require less clearance. Follow the manufacturer's instructions. If you have any doubts, it's wise to apply the same rules as for stoves.

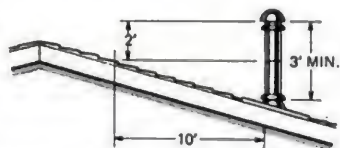
### How much clearance?

A radiant-type stove, the kind that discharges heat directly though a single-wall firebox, must be placed no less than 36 in. from a combustible wall (any wood-stud wall regardless of its facing). A double-wall circulator stove with an outer shell doesn't get as hot and can be placed as near as 12 in. to a wall.

With a heat shield on the wall behind the stove, you can reduce these clearances. It must be of noncombustible material, either 28-gauge sheet metal or 1/4-in.-thick asbestos millboard. It must be installed with metal spacers, so that it is held 1 in. away from the wall and 1 in. off the floor. This is to allow air to flow up behind the shield and keep the wall cool. Don't locate any fasteners di-

rectly behind the stove or stovepipe—they could transmit heat through the shield to the wall.

With the shield in place, stove-to-wall clearances are now as follows: For a radiant stove, 18 in. with asbestos-millboard backing, 12 in. with sheet metal; for a circulator stove, 6



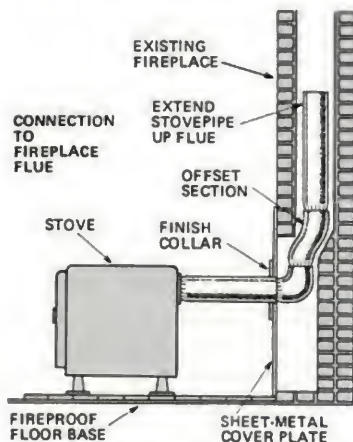
How high must your chimney be? It must extend at least 3 ft. above the point where flue passes through roof and 2 ft. above any portion of roof within 10 ft. of it.

in. with asbestos, 4 in. with sheet metal.

### Stovepipe clearances

There is an important exception to the clearances given above. Your stovepipe, which also gives off considerable heat, must adhere to its own minimum wall clearances. These are: 18 in. with no shield, 12 in. with asbestos shield, 9 in. with metal shield. If the stovepipe comes out at the rear of the stove, as it does on many models, the pipe itself, not

(Please turn to page 76)



Tying stove into existing fireplace chimney saves money, can be safe and simple. Hearth must be extended beyond stove; stovepipe must be run short way up flue.



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Amps..... 29.17/14.58	Size..... 29" L x 18" W x 14" H
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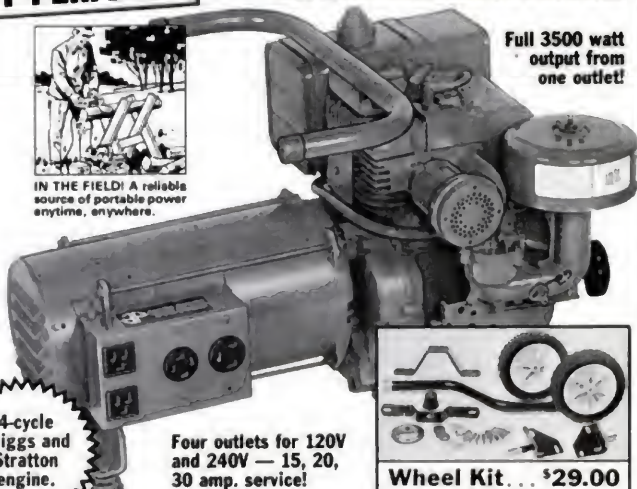
There are many reasons for their closeouts, such as: last year's models, discontinued product lines, escalating production costs, excessive competition, financial difficulties, plant closings, etc., etc.

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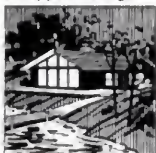
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the stove, may control the installation. This is especially true in the case of circulator stoves, which normally require less clearance than the pipe. Whatever the situation, be sure both stove and pipe meet minimum clearance requirements.

The size of the shield is determined by how far away the stove and pipe are located. It must be wide enough so that the diagonal distance from each rear corner of the stove to its side edge measures a minimum of 36 in. for a radiant and 12 in. for a circulator. The easiest way to do this is to swing a yardstick from each stove corner to the wall and mark the wall where it touches. The two marks on the wall will then represent the width of the shield.

The shield that runs up behind the stovepipe can be narrower—18 in. on either side, also measured on the diagonal. However, it generally is simpler, and looks better, to carry the same-width shield all the way up the wall. If your stovepipe comes to within less than 18 in. of the ceiling before passing through the wall, you'll also need a shield above it to protect ceiling joists.

If the wall behind your stove is solid masonry with no wood studding behind it, it's not considered a combustible wall and you can eliminate the shield. But follow manufacturer recommendations for installation; protect any nearby combustible surfaces.

### Fireproof floor base

As already noted, not even a base of brick, slate or tile is considered adequate by itself to protect a wood floor under a stove. If the bottom of the stove stands 18 in. or more above the floor, you need a base of 24-gauge sheet metal underneath. If it's less than 18 in. from the floor, put down ¼-in. asbestos millboard first and top it with 24-gauge sheet metal. (For stoves with less than 6 in. bottom clearance, see manufacturer instructions for building up a fireproof platform.)

The base must extend a minimum of 18 in. beyond the stove in front and 6 in. on the other three sides. And remember—if you want the decorative appearance of a brick, slate or tile surface, this must go over the sheet-metal sub-base.

### Installing stovepipe safely

For average stovepipe diameters (6 to 10 in.), use 24-gauge corrosion-resistant steel. Some experts advise against using galvanized pipe because the zinc used in the galvanizing may vaporize at high temperatures and give off toxic fumes.

Keep the run from stove to flue as short as possible, preferably no more than 5 to 9 ft., and use no more than two 90° bends. Excessive turns impede good draft flow. Pitch horizontal runs ¼ in. to the foot up from stove to flue, and assemble the pipe sections so the crimped or male ends face toward the stove. This encourages creosote and moisture condensation to run back into the stove, instead of collecting in the flue. Fasten the sections together with three sheet-metal screws equally spaced around each joint.

When passing through a wall, the stovepipe must be fed through an insulating collar called a thimble. This is a double-wall ring that allows air to circulate around the hot inner pipe and dissipate heat. If the pipe feeds into an existing chimney flue, the flue must be at least 25 percent larger for proper draft.

Connecting the pipe to an existing fireplace flue is an excellent way to avoid the cost of a new chimney. In this case, the fireplace opening must be sealed with sheet metal and the stovepipe extended a short way up the chimney throat, usually the length of one pipe section. Assemble all joints with furnace cement, as well as with screws.

### Prefab chimneys make it easy

Ordinary single-wall stovepipe can be used only for the short run from stove to flue. It can't be run between floors or in any other enclosed areas. For this, you need insulated flue pipe.

If there is no existing flue to tie into, you can use a prefabricated metal flue. This is relatively inexpensive and easy to install. Be sure, however, that you buy only a UL-listed "Class A" metal chimney. This comes in two styles—a triple-wall type insulated by air circulation and a double-wall type packed with solid insulation. Follow the manufacturer's instructions for proper installation.

Whatever the type, a chimney must extend a minimum height above the roofline to insure adequate draft. It must project at least 3 ft. above the point where it passes through the roof and stand 2 ft. higher than any surrounding portion of roof within 10 ft. (see drawing, page 76). Heed manufacturer instructions for bracing a chimney, especially if it projects more than the minimum 3 ft. In heavy storms, prefabricated metal chimneys are more vulnerable to wind damage than masonry and may need extra support.

### Tips for safe operation

Along with proper installation, a wood or coal stove must be operated carefully to avoid the chance of fire. Some people go to elaborate lengths to see that a stove is fully shielded, then do something silly like placing a cardboard carton of dry kindling right next to it. Keep your wood supply, as well as all rugs, drapes, pillows, furniture and other flammables, well away from the stove.

If you buy an old, secondhand stove, examine it closely for cracks, missing parts and other defects. Never burn coal in a wood stove unless the manufacturer specifically recommends the use of coal. And never overfire a stove to see how hot you can get it. Excessive heat may start a fire.

If you have the type of stove that also serves as an open fireplace, don't leave it unattended with the doors open. Never use flammable liquids to start or rekindle a fire. These can flare up explosively if hot coals are present. Don't use a stove for trash disposal. Flaming bits of paper can fly up the chimney and fall on the roof or start a flue fire. Keep a window open slightly to allow fresh air to circulate. This is especially important when operating a stove continuously over long periods or when burning coal. Clean out ashes regularly and store them in a covered metal container.

Check regularly for creosote buildup in the stovepipe and chimney. Creosote is a highly flammable by-product of wood combustion and can cause a violent and frightening flue fire. A yearly inspection is the recommended minimum, but more cleaning may be necessary.

### Get ready for inspection

No matter what kind of installation you make, most local codes require that the finished job be inspected and approved. This is actually to your own benefit as it will help to insure the safety of your family and home.

Advise your building department that you are making an installation and ask for its recommendations. Often it can offer helpful advice. In most areas, building permits are required for installing chimneys and stoves. Also notify your insurance company, or your policy may be voided in the event of fire—any fire.

If the work is done right, you'll have the satisfaction of getting a favorable inspection *plus* the security of knowing that you can keep the home fires burning... without burning down your home.



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# THE PM GARAGE

## CAPSULE REPORTS ON NEW AUTO PRODUCTS

### The thread fixer

One of the most frustrating experiences in any kind of auto-repair work is stripping a bolt. And that can hang you up for quite a while. To remedy this unpleasant turn of events, I've made the Threadmaster thread-reformer tool a permanent member of my toolbox. It can handle any kind of bolt up to 1 inch in diameter.

It has two hardened-steel blades, one movable and the other stationary, which clamp over the threads. Rotate the tool around the bolt until the valley of the thread has been re-established. You might find that



Threadmaster tool reforms crossed threads quickly with hardened-steel jaws.

peaks of threads rise higher than normal after reforming. You can bring them down with the aid of a small file.

The tool is \$24.98 and is available from H&S Co., 167 North San Marino Ave., Pasadena, Calif. 91107.—T.A.

### Double-action pliers

Most of the things weekend mechanics work on don't have snap rings. So snap-ring pliers aren't a common purchase. When you do run into a snap ring, however, you either struggle or you go out and buy pliers for the job—and then for either internal or external rings. Naturally, the next time you need snap-ring pliers, it's for the other kind of snap



In its first position, the snap-ring pliers can disengage internal-type snap rings.



With the arm engaged between the two handles, you can remove external snap rings.

ring. The whole matter is a version of Murphy's Law.

You can be sure of winning if you buy snap-ring pliers that handle both types of rings. I've used one type that worked with both, but it wasn't all that convenient. Now there's one that is very easy to use, and it lists for just \$13.

In basic form, it contracts internal rings. Disengage an arm from one handle, swing it over to the other handle, and you lock the handles together. When you squeeze, the handle that held the arm now is free to flex on a pivot and expand an external ring. It's made by Lisle Corp., Clarinda, Iowa 51632, and it's available at auto-parts retailers.—Paul Weissler

### Emergency ignition system

If you believe in the Boy Scout motto, "Be prepared," you'll love a new, portable, emergency ignition system. With this new "black box," you can have the car running in minutes after almost any routine ignition



The emergency ignition system plugs into most cars. It can override the failed parts. failure. The box is under \$50 list, and works on any car.

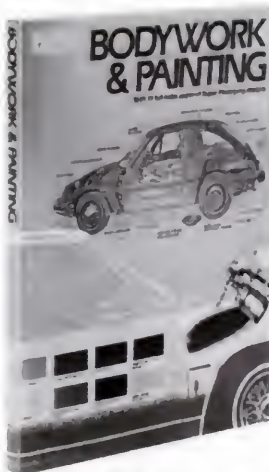
The box contains an electronic control unit, ignition coil and triggering system. Connect it to the car

battery and plug its wire into the distributor cap. Disconnect the primary wiring from the distributor and uncoil the wiring of the remote switch provided. Bring the switch into the car, crank the engine with the key switch and, while the engine is cranking, flip on the switch.

If you have a General Motors car with high-energy electronic ignition and the ignition coil bolted on the cap, you need a special adapter that's included. The kit is available from K-D Manufacturing Co., 3575 Hempland Rd., Lancaster, Pa. 17604, or at auto-parts stores.—Paul Weissler

### Slaphammers and body putty

If you've ever been reluctant to try your hand at body repair because you lacked the skills, here's some good news. It's a new book, called *Bodywork and Painting*, that shows how you can achieve professional results. This 240-page book covers everything from simple touch-up work to laying fiberglass. An example of its contents is found in our "Car



New book covers everything you need to know for any professional-looking repairs.

Care Guide" article, *How to Repair Rust Damage on Body Panels*, on page 154.

It's available by mail from Hearst Books, Bodywork and Painting, Box 983, Hicksville, N.Y. 11801. Postpaid price is \$9.95 for soft cover, \$14.95 hard cover. Make check or money order payable to Hearst Books.—T.A.



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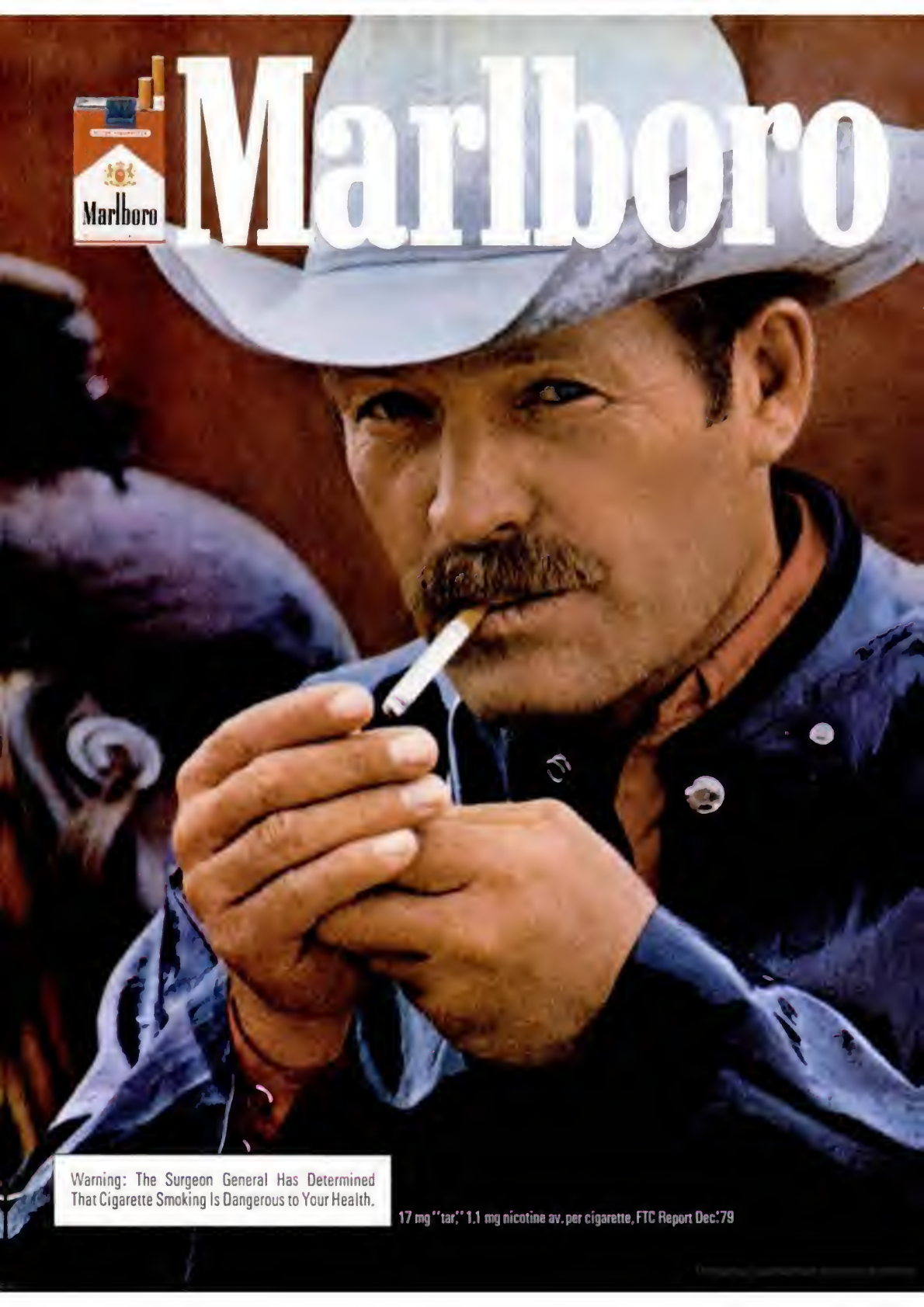
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# Can the **ROTARY** engine survive the '80s?

Once maligned as fuel-thirsty and unreliable, Felix Wankel's creation shows large reserves of untapped potential.

by Tony Assenza AUTO EDITOR

**K**enichi Yamamoto is a man who stands alone, in all of the automotive world, in his belief that the rotary engine is still a viable and in some instances a superior alternative to the piston engine. As head of the advanced product research for Toyo Kogyo, he was the one who convinced Mazda management way back in 1960 to apply for a license to build the rotary. In those days *NSU Motorenwerke AG* held the world rights to Felix Wankel's creation. NSU's doors were being pounded on daily by virtually every company in the world that had anything at all to do with internal combustion engines. The list of applicants reads like a who's who of the industrial world: Curtiss-Wright, Daimler-Benz, the Krupp group, Alfa-Romeo, Rolls-Royce, Porsche, Outboard Marine



Corp., Nissan, GM, Ford, AMC, Kawasaki, BSA and right on down the line to a modelmaker who made use of rotaries to power

radio-controlled airplanes. With all those heavyweights shouldering their way to the head of the line it was only by intervention of the then German ambassador to Japan, Wilhelm Haas, that Toyo Kogyo ever got a crack at building the rotary. It's ironic that tiny Mazda, with limited resources, was the only company ever able to make the strange thing work.

## 5000 junked engines

What Mazda got for its license fee from NSU was a set of drawings and a 400-cc, single-rotor engine, model KKM 400. Yamamoto and crew quickly set about to build a similar engine. When it was put on a test stand their engine blew clouds of white smoke, rattled like a tin can full of rocks and self-destructed after approximately 200

PM art: Pat Ruggero

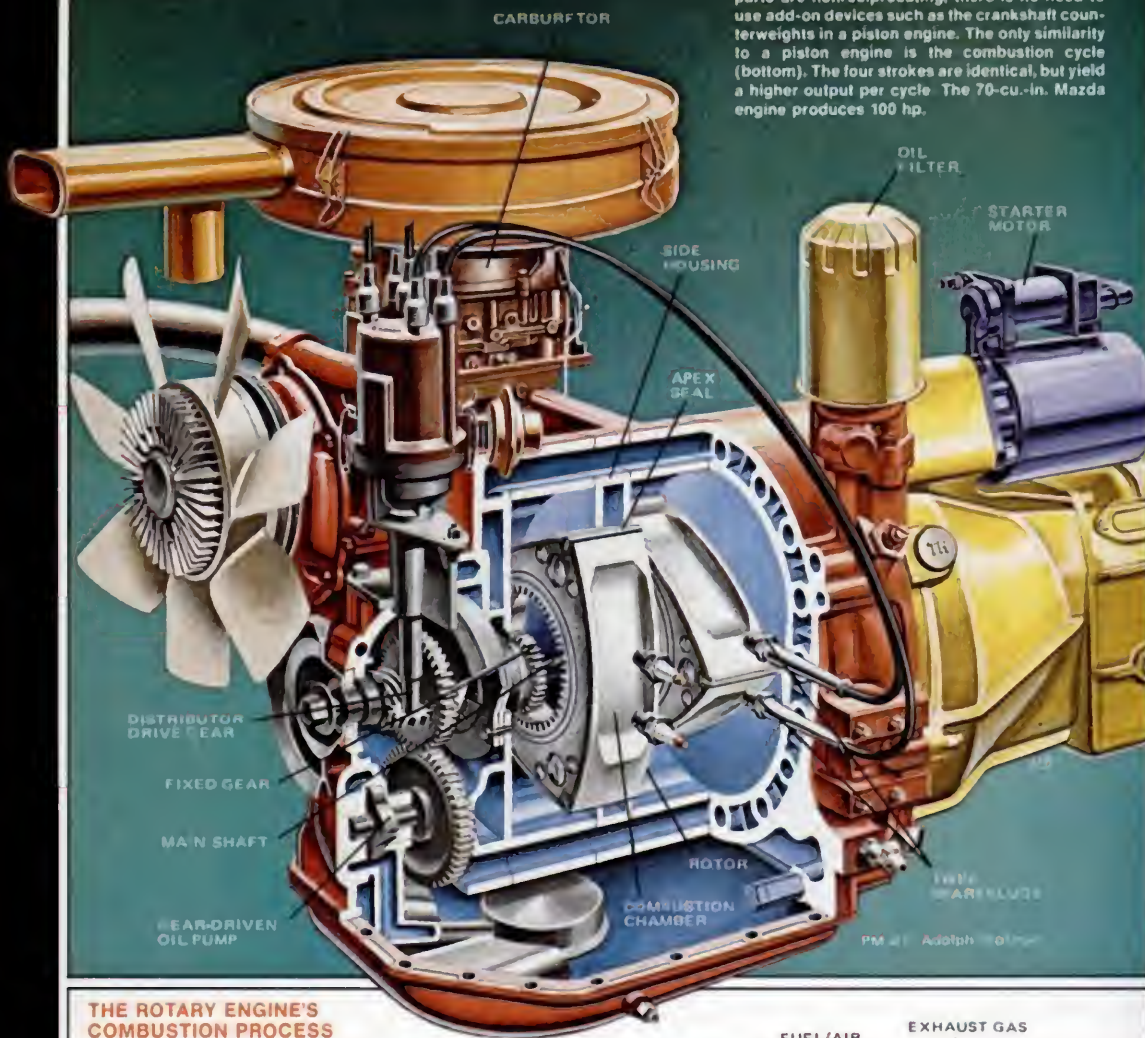


The 1981 RX-7 will have a revamped nose and tail section and upgraded interior. Mileage will increase by 20 percent.

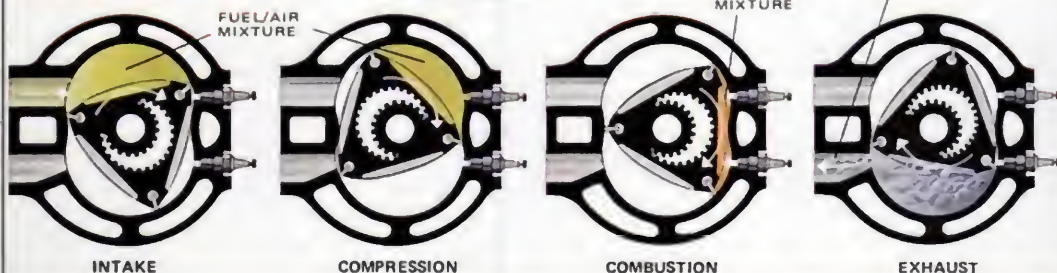


## The two-rotor Wankel: Where others failed, Mazda succeeded.

Due to fewer working parts of a rotary engine compared to a piston engine, there is less friction to rob power and increase wear. Since all moving parts are nonreciprocating, there is no need to use add-on devices such as the crankshaft counterweights in a piston engine. The only similarity to a piston engine is the combustion cycle (bottom). The four strokes are identical, but yield a higher output per cycle. The 70-cu.-in. Mazda engine produces 100 hp.



### THE ROTARY ENGINE'S COMBUSTION PROCESS





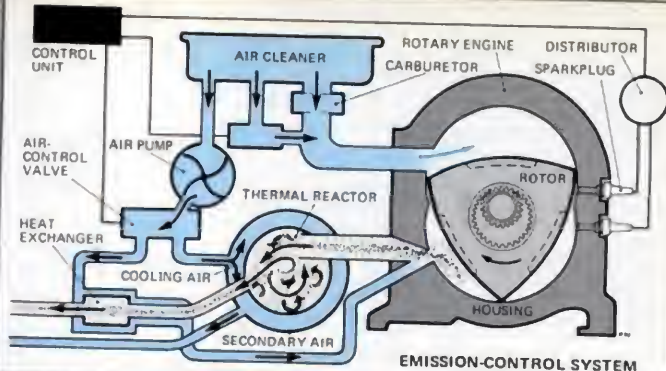
hours. Between November 1961, when that first engine blew, and October 1963, when the Mazda 110 S, the first Mazda ever to carry a rotary engine, was introduced, Yamamoto-san had filled Toyo Kogyo's back lot with 5000 rotary engines which had blown up during testing.

The problems the Japanese encountered were the same ones that frustrated every other manufacturer that tried to build a rotary. These problems were excessive wear of the apex seals, failure of the side seals, idle-speed instability and ring-gear and fixed-gear failure.

These problems, however, were not inherent faults in the rotary design but rather a matter of finding the right materials for the job. Mazda and the others involved in rotary research were trying to find answers to questions which had never before been asked. It was essentially a matter of related metallurgical and machining technology catching up with a design that was, and, in the opinion of Yamamoto, still is ahead of its time.

The seal failures, for instance, were solved by spraying powdered steel at high temperature on the inside of the rotor housing. This left a smoother and harder surface which resisted wear. Along with this system, the apex seal was also redesigned by drilling crosswise holes near the tip of the seal and then another hole lengthwise to intersect with the first hole. This new apex seal was named "cross-hollow" seal and eliminated the problem.

The low-speed instability problem was solved by relocating the intake port. The KKM 400 and the early Mazda units used a peripheral port for delivering fuel into the rotor housing. The peripheral port



The heart of the rotary engine's emissions control system is the thermal reactor. Reducing emissions to a harmless state, it completes the combustion of gases that have been expelled from the engine by the injection of fresh air.

introduced the fuel/air mixture directly onto the face of the rotor. The design team discovered that by introducing the fuel on either side of the rotor, idling roughness disappeared. The one drawback to using side ports, however, is a decrease in horsepower. But in the interest of driveability and acceptable idling vibration, the trade-off in power was inevitable. The current rotary racing engines, in fact, are designed with peripheral ports because rough idling is the last thing race-car drivers worry about.

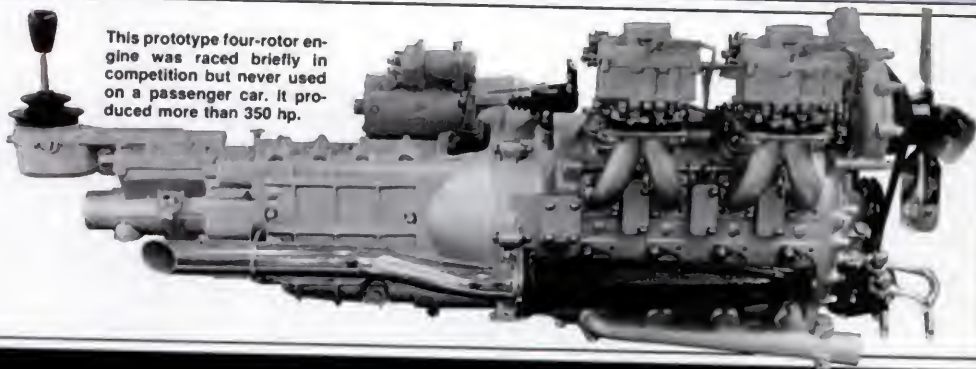
#### Mazda's revenge

Soon after the R100 coupe was introduced in the American market, in 1968, the country went berserk with a wave of rotary mania. It seemed as if the accolades and laurels heaped on Mazda would never stop. Wall Street prognosticators predicted that by 1980, 90 percent of domestic cars would be powered by rotary engines. The automotive and popular press called

it the greatest invention of the century. Robert Templin, director of GM's special product development group, said of the rotary that it is "the only path we know to simultaneously improve fuel economy, vehicle performance and emissions." GM's expectations were so high that Thomas Murphy, then vice-chairman of that firm, authorized \$50 million to buy a license to manufacture the engine. Murphy even kept a model of a rotary on his desk. And that's extremely rare for a financial type.

There were good reasons for all the excitement from the various sectors of the car world. The enthusiasts loved the rotary because it was fast and cheap. The manufacturers loved it because it would streamline production methods and significantly reduce the unit cost compared to a piston engine. Dr. David Cole, auto engineer and son of then GM president Edward Cole, said of producing the rotary: "There is a point in savings where

(Please turn to page 206)



This prototype four-rotor engine was raced briefly in competition but never used on a passenger car. It produced more than 350 hp.

## PM OWNERS REPORT: MAZDA RX-7



conditions that can be found in any part of the country, and our owners have had two years to log lots of miles.

When the RX-7 first set foot on these shores, Mazda dealers already held waiting lists 15 weeks long. The base 1978 RX-7 carried a sticker price of \$6540, but to give you an idea of the huge demand, some early owners in Los Angeles were advertising their brand-new cars for as much as \$11,000! Several dealers, too, took advantage of the shortfall and, after loading cars with every conceivable accessory, priced them at \$10,500.

Demand today isn't quite what it was two years ago, but Mazda dealers still have no trouble selling all the RX-7s they can get.

What creates this tremendous demand? Our survey shows that it's not just one thing. It's not simply styling or price or performance or comfort alone. Rather, the RX-7 owners we questioned gave us the impression that a lot of different factors all conspire—that overall, Mazdas simply do a lot of things right.

A self-employed Californian, for example, told us, "I went out and compared. Up against the Corvette, the Porsche 924 and the Datsun 280-ZX, the RX-7 is by far the best car for the price."

A New York architect agreed. "Where else can you get so good-looking a sports car at such a reasonable price?"

Styling played a leading role in getting owners interested, but then so did engineering.

"I bought the RX-7 to get a rotary engine in a sports car," mentioned a California driver's license examiner, who also happens to be a Sports Car Club of America national rally champ. "I've been waiting for a sports version ever since I bought my first rotary Mazda back in 1972."

A New York plumbing supplier: "I think it's a cleverly designed car throughout, and everything fits with precision."

New York sales manager: "I'd driven a Mazda RX-4 for years without any



At a current base price of \$7945, RX-7 has stand-out styling, performance, quality.

**T**he world's only rotary-engine sports car drew rave reviews from the automotive press when it appeared in mid-1978. And the raves continue unabated. Today, though, it's the owners who are licking their chops. The 1000 Mazda RX-7 purchasers from New York and California whom we surveyed for this report waxed even more enthusiastic than the magazine editors.

Since many people wonder what it's like to live with a rotary engine and still ask about its durability, we made an extra effort to survey owners of the first RX-7s—the 1978 model. We limited our survey to the two big states for RX-7 sales: California and New York. These two states are certainly representative of the kinds of road and weather

BY MICHAEL LAMM WEST COAST EDITOR

## Enthusiastic owners tell us they could pay more, but wouldn't get more

Owners would rather have sliding sunroof than lift-out option.

Glass hatch lifts for access to 13.8-cu.-ft. cargo deck.

Sophisticated four-link rear axle has coil springs, Watts linkage, gas-filled shocks.

PM photos: John W. Lamm





problems. I liked the RX-7's appearance and performance; so I bought it."

Owners had a good deal of praise for the RX-7's performance and handling, too. A New York market researcher chuckled, "This car has great speed and fantastic acceleration. The longer you hold down the gas pedal, the stronger the shove on your back."

A New York sound-systems technician: "You get a certain feel behind the wheel. The rotary engine is smooth, free-revving, and willing. At high speeds, there's very little wind noise, proving that the aerodynamic look is more than a look."

A California economist: "Super overall handling—steering response, cornering, everything. Very quick acceleration. I also like the quiet ride and comfort."



Tach combines voltmeter. Owners say seats feel better than in earlier models.

And a California real estate agent: "It's a fun car to drive. Terrific handling, roadability and acceleration."

Acceleration, of course, brings a certain penalty in fuel mileage. While most RX-7 owners were happy enough with their miles-per-gallon figures, 17.8 percent felt they weren't getting all they should. Actually, though, the RX-7 came closer to its Environmental Protection Agency (EPA) estimates than most.

The EPA says that the five-speed RX-7 ought to get 17 mpg in town and 28 mpg on the highway. Our owner sampling reported 18.5 city/24.7 highway for the overdrive five-speed—better in town than the EPA estimate and only about three mpg off the EPA's traditionally optimistic highway figure.

The owners who were most disappointed in their fuel mileage, we noticed, were those with automatic transmissions. Here, their 16.8 city/21.1 highway did indeed fall short of the ideal EPA estimates.

There was very little disappointment, though, in the area of workmanship. Here, 93.8 percent of our respondents rated it good to excellent. "Every seam fits," jotted a New York power-company official, and a California insurance agent reported, "In 25,000 miles, my RX-7 has needed no repairs and has turned up

(Please turn to page 200)

## Why the RX-7 goes hmmm

Toyco-Kogyo launched its first rotary engine in a sports car—the 1967 Mazda Cosmo Sport. Three years later, the R-100 arrived in America, and to date Mazda has sold nearly a million Wankel-engined vehicles.

The mid-1970s saw the rotary plagued with problems and bad publicity, all of which evaporated when Mazda unveiled the RX-7 in 1978. The motoring public immediately and enthusiastically endorsed this car, touting it as more for the money than any buyer has the right to expect—a repeat of the 240-Z phenomenon.

The RX-7 for 1980 comes in two levels of equipment: G and GS. The basic G model has a long list of standard items that include a four-speed gearbox, AM/FM stereo, tach, steel-belted radials, styled wheels, clock, rear defroster, and vanity mirror. The GS adds a five-speed overdrive transmission, rear sway bar, electric hatch release, timed wipers, console, map pockets and more. Airconditioning, plus a three-speed Jatco automatic transmission, is available in both models, and the GS can be ordered with aluminum wheels and a lift-off sunroof.

The utilized body is thoroughly rust-proofed and Mazda guarantees the engine for three years or 50,000 miles.

RX-7s finished the 1979 Daytona 24-hour race fifth and sixth overall and 1-2 in their class. On the Bonneville salt flats, another specially prepared RX-7 set a world-class speed record of 183.904 mph, and that's really hmmm.

## A PM SURVEY BASED ON 4,269,721 OWNER-DRIVEN MILES

Wankel rotary boasts 100 hp, 50,000-mile parts warranty.



Aerodynamic shape of 1980 RX-7 does more than turn heads—it helps give the car a 124-mph top speed. Twin-rotor Wankel delivers 100 hp and would keep revving past its 7000-rpm redline without a governor. New sealing technology prolongs engine life and gives admirable fuel economy. Few owners reported mechanical problems of any sort, and most praised rotary's power, and smoothness.

Slim design gives 0.36 drag coefficient with headlights retracted.

Lightweight engine rests behind axle centerline for 49 weight distribution.



# The clock that splits

Navigating in deep space, measuring movement of the Earth's crust—both depend on counting the vibrations of excited atoms.

by Gurney Williams III



Heart of an atomic clock: New speed, old principles.

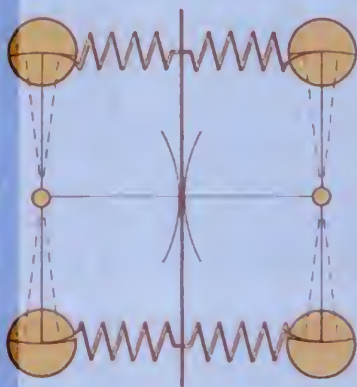
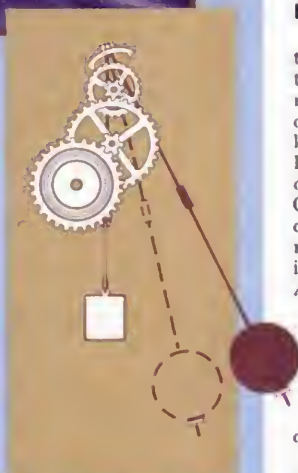


Photo (top) shows first marine clock, c. 1735. In schematic (above), springs, wound against each other, joined two pendulums in parallel.



The drive mechanism relied on a "grasshopper" armature to translate pendulum action to gears.

**L**ike a flat-nosed rocket about to take off, a blue cylinder stands straight on its mounting, a sunset glow radiating from its lower end. Excited hydrogen atoms course through its chambers, reaching speeds of 6000 mph, careening off Teflon-coated chamber walls and pulsing in lock step with each other at more than a billion times a second.

You wouldn't guess what it is from its appearance, or from the bright logo of the National Aeronautics and Space Administration (NASA) surprinted on the blue: The cylinder is the heart of a clock.

The hydrogen maser clock doesn't tick. Apart from the flow of atoms, it has no moving parts, no cogs, no escapement. It does, however, carry the science of timekeeping into a new realm, measuring units so small they are almost impossible to imagine: trillionths of a second. A trillionth of a second is roughly the time it takes for light to travel the thickness of 10 pages of PM. In a trillionth of a second, a supersonic transport flying at Mach 1 moves a distance approximately equal to the length of a line of just 10 atoms of copper.

It's an esoteric realm. But in recent years, measurement of such tiny fragments of seconds has become indispensable to scientists involved in practical work—from studying earthquakes to tracking deep-space probes.

## Deadly reckoning

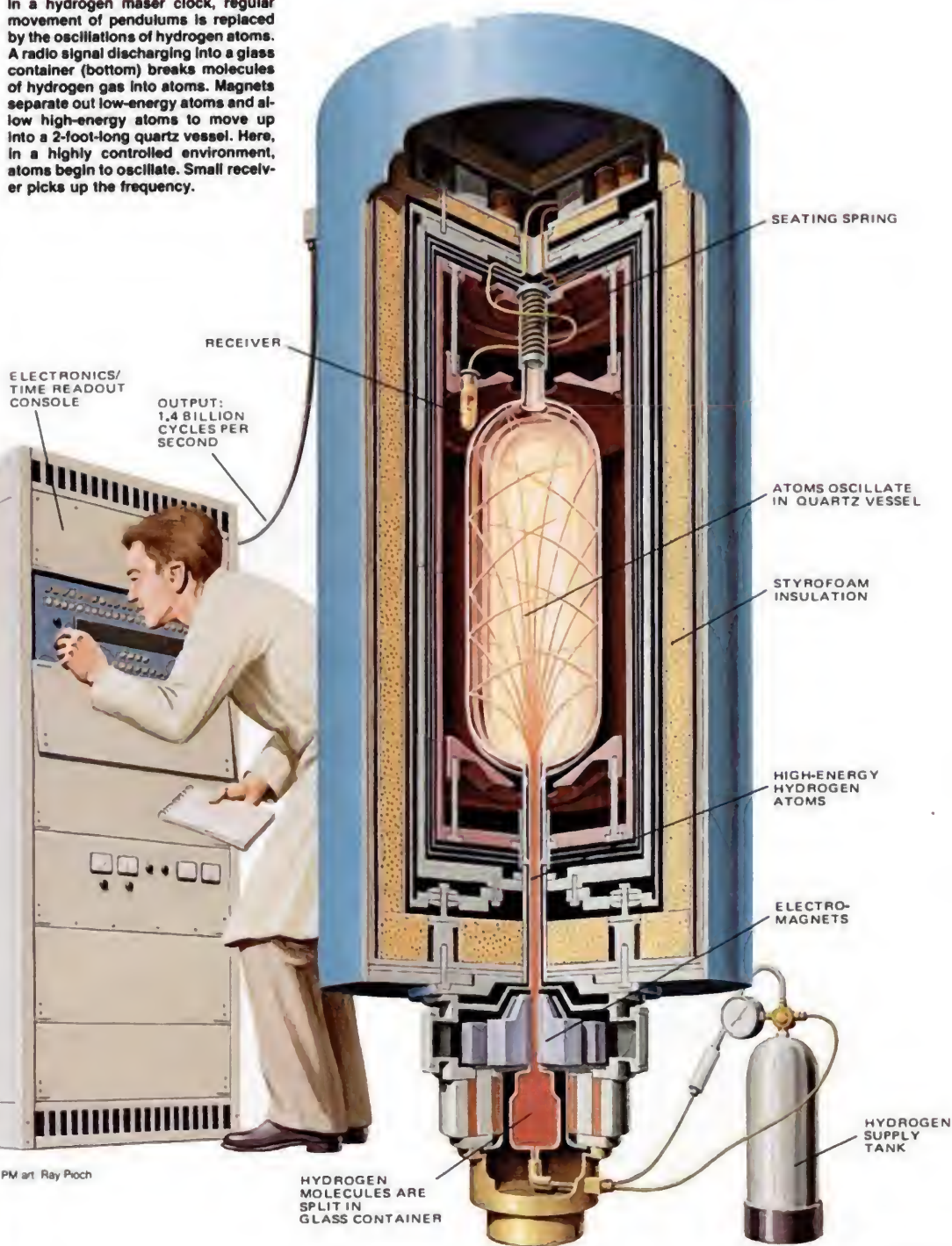
Designers have dreamed of splitting the second for at least two centuries, often under the pressure of navigators. Keep track of the seconds, 18th-century ship navigators knew, and you could calculate your longitude by comparing local time—obtained by star sightings—with Greenwich, England, time. But clocks were so inaccurate that many navigators stuck with dead reckoning. As a result, many seamen died. Aboard the British ship *Centurion* in 1741, for instance, 70 to 80 sailors were killed by scurvy while the captain wandered west to east to west again, guessing at his longitude and looking for an island where he could pick lifesaving vegetables.

The British Parliament had recognized the problem earlier in the 18th century, offering a 20,000-pound reward (about \$1 million in today's currency) for any "generally practicable and useful" method of finding



# seconds—into trillionths

In a hydrogen maser clock, regular movement of pendulums is replaced by the oscillations of hydrogen atoms. A radio signal discharging into a glass container (bottom) breaks molecules of hydrogen gas into atoms. Magnets separate out low-energy atoms and allow high-energy atoms to move up into a 2-foot-long quartz vessel. Here, in a highly controlled environment, atoms begin to oscillate. Small receiver picks up the frequency.





Dish antennas spotted around the nation pick up identical radio signals from quassars, starlike objects in space. Hydrogen maser clocks measure differences in times of arrival of staticlike signals, enabling the calculation of distance between stations—within a few centimeters. High accuracy should enable researchers to observe even a slight movement between Earth's "plates," improving earthquake predictions.

longitude at sea. The money went unclaimed for 50 years until John Harrison, a self-educated carpenter's son, tested a large (5.2-inch-high) silver watch, the fourth in a series of models he made, on a voyage from England to Jamaica. Nine days out, Harrison predicted the ship would reach Madeira the following day. The captain, relying on dead reckoning, offered five-to-one odds that Harrison was wrong. But the ship came within sight of Madeira the next morning, and eventually Harrison won his reward.

Harrison's first experimental clock (shown on page 88)—the first accurate marine timekeeper—was an elegant contraption of pendulums connected by springs. The swaying balls controlled the movement of oaken wheels, turning dials that displayed seconds, minutes, hours and days. An ingenious touch: Bimetallic rods automatically varied the tension on the springs to compensate for any temperature changes. The clock ran 38 hours on one winding.

Today's atomic clocks—running five years on a single liter of hydrogen—make Harrison's designs look

like antique windup toys. But the latest timepieces are remarkably similar to the oldest of accurate clocks.

In the hydrogen maser, the swinging of pendulums is replaced by the oscillation of hydrogen atoms. High-speed electronic counters do the same job as the wooden teeth on Harrison's wheels, which moved a notch with each swing of the pendulums. A digital readout replaces dials to display the time. Temperature changes are still a worry: A small computer keeps the temperature inside the Styrofoam-insulated chambers within 50 millionths of a degree of an ideal working climate.

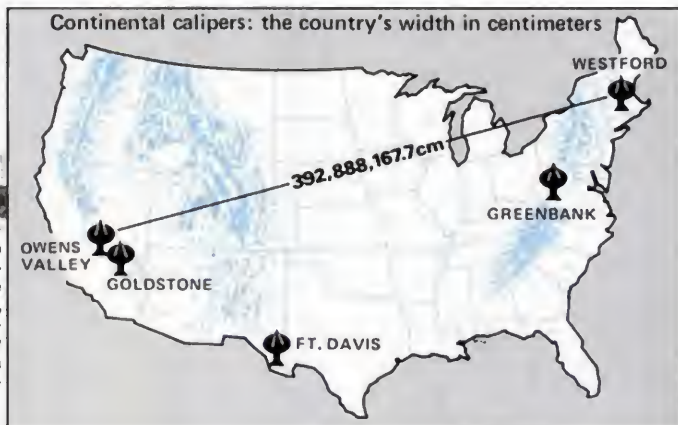
### The heart of a hydrogen clock

The latest generation of hydrogen maser clocks is evolving at Goddard Space Flight Center near Washington, D.C., a sprawling collection of laboratories and a tracking station where satellites periodically "dump" data—all time-tagged with atomic clocks.

Victor S. Reinhardt, the man in charge of developing the clocks, led me on a tour of a lab where a technician was working on the heart of a

hydrogen maser. Like a doctor checking out a patient's complexion, Reinhardt took a close look at the color at the base of the yard-high cylinder containing the clock's works. The hue of the hydrogen was rosy, one result of successfully breaking molecules of the gas into atoms. "Looking pretty, Vic," a technician said. A washed-out color—a case of what Goddard researchers with a note of dread call "the whites"—would indicate trouble and downtime.

But there's comparatively little of that, perhaps partly because the principle of the clock is fairly simple and partly because microprocessors



today keep a careful watch on the clock's functioning and help trouble-shoot it.

The hydrogen maser (an acronym for Microwave Amplification by Stimulated Electromagnetic Radiation) is triggered by a radio signal discharging into a glass bottle full of hydrogen. "It's like a fluorescent light," Reinhardt told me. "You generate a discharge and molecules are ripped apart into charged atoms," giving off the glow.

Two kinds of hydrogen atoms result from this molecule-splitting stimulation. Atoms in the lowest energy state are rejected as they pass out of the glass bottle and into an electromagnetic tunnel. High-energy atoms continue through the tunnel and, at the other end, enter a 2-foot-long quartz container.

The atomic oscillation—the modern equivalent of swings of a pendulum—takes place in this chamber. "It's unstable in there," Reinhardt said. "The atoms want to get to the lower state." But for a fraction of a second, nothing happens. Then one atom at random drops, like a marble rolling off the rim of a well, into the lower state. The result is controlled



atomic pandemonium. The fall of one atom sets off millions of other falls. "It's like an explosion or avalanche," Reinhardt said. As the atoms change their states and give off energy, new atoms enter the chamber to take their place.

All of this happens within a second, in the absolute silence of the quartz. More than just giving off energy, though, the atoms begin to oscillate, separately at first and then all together, at about 1.4 billion cycles per second.

### A bunch of floating tops

To explain why this frequency develops, Reinhardt drew a picture of a small lake, its surface dotted with boats, each carrying a spinning top. "The top is the internal vibration of the atom," he said. "The boat is the whole atom." The energy of the identically made tops aboard each boat sets up waves in the water.

"Every time the wave comes along, the top tips a bit, yielding some energy to the wave. After a while, if the tops are all made the same, you get a steady sloshing back and forth. Then you measure the frequency of the wave at one end of the pond." In the hydrogen clock, a small coil at the top end picks up the oscillation and conveys it to an electronics package that counts pulses and totes them up into seconds.

When the counter reaches 1,420,405,751-and-a-fraction cycles, one second has passed and the count begins again.

For short-term use (up to 1000 seconds), these clocks are the most stable ever built. Two of them put side by side would not differ by more than one part in 100,000,000,000,000. Long-term stability isn't bad, either: The same two clocks wouldn't differ by more than a millionth of a second over three years.

Such stability is not without a price. Goddard built just two of these clocks last year, and each cost about \$300,000. But the payoff in data covers the cost of the masers many times over.

### Why science needs time

Deep-space probes often rely on precision timekeeping. NASA scientists tracking space probes measure the time it takes radio signals to travel to and from robotic spacecraft. Tracking experts convert time to distance so they can locate probes and make course corrections necessary for rendezvous or orbit with distant planets. There is little room for error: A mistake of a billionth of a second in timing could result in an error of hundreds of kilometers in the vicinity of the giant outer planets—enough to blow a mission. The deeper we probe outer space, the more we need extraordinarily stable clocks on Earth.

Atomic clocks also make possible highly accurate, long-range Earth surveys—measurements of land movements that may help scientists understand why earthquakes occur.

Robert Coates, a scientist at Goddard where global-scale surveying techniques are under development, told PM how the system works. Widely separated receiving stations pick up radio noise signals from some astronomical source, typically quasars.

The radiation from a quasar is a complicated random signal, falling

(Please turn to page 197)



Consoles at Owens Valley, Calif., station display time-marked data from space for researchers studying land movement.

## WHAT CLOCK DO YOU BELIEVE?

**T**he Goddard maser clocks are the latest in a line of atomic timepieces that in recent years have become the standard for most of the world. With their superior stability, they have easily beaten out older time standards: the daily turning of the Earth, or the yearly orbiting of the Earth around the sun.

The trouble with the Earth as a time standard is that it's slowing down; as a clock, it appears to have lost about 19 seconds since 1958. It also wobbles as it rotates, making measurement difficult. Because of problems like these, the 39 nations belonging to the General Conference of Weights and Measures decided a decade ago to officially establish a different time standard, called Coordinated Universal Time. That time, kept officially in Paris, is just eight years old: It began Jan. 1, 1972, and it's based on readings of cesium clocks—an older form of atomic timepiece than the maser—from many nations.

But despite the move toward a new and more stable standard, it's still pretty hard to figure out what time it is, if

you want to know exactly. Measurements differ. For instance, as of last January, the U.S. Naval Observatory—one main timekeeping center in this country—came up with a time about one millionth of a second different from the time at the Paris Observatory. Japanese clocks always run about 20 millionths of a second out of sync with U.S. timepieces, for unknown reasons. The Chinese haven't yet switched to atomic time. So they don't even get on the charts kept in Paris showing what everyone thinks is the correct time.

The changeover to atomic time isn't complete, and probably never will be. Navigators still need astronomy to locate themselves, which means that the atomic time standard occasionally has to be brought back in line with the stars. So about once a year, participating nations agree to add a "leap second" to keep time standards in rough agreement.

So what time is it? Depends on when you ask, and what flag you're under.—G.W.





**1** All the equipment above fits neatly aboard and out of sight in specially divided shipshape shelves and cabinets.

**2** Photography can be a moneymaking hobby. Complete darkroom equipment fits safely under one dinette seat.

**3** Top of a discarded dresser has become a small table for typing travel stories and stays permanently in place.

**4** Envy of other campers is galley tool-board that holds short-order utensils in place on the go with shock cords.







# A camping expert fits out his RV

For on-the-go adventure, retiring in comfort or both—here's how a hobbyist does it.

by E. P. Haddon

**P**lan ahead, and you can fit out your recreational vehicle for almost any activity—or a dozen of them. Take advantage of unused space, and you'll be able to stow the essential gear for boating, fishing, hunting, photography and hiking. The assortment of gear that fits in my economy-size rig continues to amaze owners of highway dreadnoughts twice its size.

For a home on wheels when you retire or long before, today's RV provides the perfect base for comfort and adventure afield. All you have to do is examine every nook and cranny aboard. Then customize each to your own needs, hobbies and sports interests.

Shipspace and secure storage is the secret. The first shakedown cruise with our latest rig showed that our 11 cabinet doors offered easy access to the overhead compartments for stowing groceries and other small items. After a day on the move, however, nothing remained where it had been placed. From front to rear, everything had shifted.

The first remedy was to install ¼-inch-plywood partitions to divide the spaces inside each compartment and assure a permanent berth for everything. Dishes are now safely held in cushioned racks designed for RVs and screwed in place. Glasses ride on other racks attached to the inner sides of the cabinet doors. Other overhead cabinets, some with subpartitioning, hold everything in place from groceries to appliances and clothes.

Opposite the dinette and beside the combination bunk/seat, an 18×36-inch oak table (once a discarded dresser top) fits neatly atop a single folding leg. It's an ideal accessory worktable, does double duty serving guests in for dinner or a drink, and has become so indispensable that we leave it permanently in place. On the underside of the table, a shallow partitioned tray provides a handy hiding place for innumerable small objects. Behind, on the wall, are two magazine racks.

Items originally stowed inside the two dinette seats were invariably lost in a jumbled hodgepodge. Two new plywood partitions create three compartments in one to store backup canned goods for extended back-country trips. There's also space for a portable typewriter, an attache case protected with foam plastic, a little GE electric sweeper and several pairs of hiking boots.

Beneath the other dinette seat is a complete hobby

*(Please turn to page 194)*





DETROIT  
'81

# Driving the GM

by Gary Wiltzenburg  
DETROIT AUTO EDITOR

**T**his is the proverbial calm before the storm as General Motors introduces redesigned personal coupes and some significant new engineering features in the midst of heavy preparation for its front-wheel-drive "J-car" unveiling next spring. So heavy were the preparations, in fact, that magazine writers at the '81-model preview in July saw literally dozens of the attractive little "Js" running around GM's Milford, Mich., proving ground on various test schedules, not to mention the occasional '82 Camaro and Firebird and early



The Buick Electra (top) and Regal (above) bear visible signs of aerodynamic research. Their sloped noses and higher decklids have reduced drag coefficients, improving mileage. One Regal option is turbocharged 3.8-liter V6.





# models

prototypes of some other future models.

The "A-special" mid-size personal coupes, totally revamped and downsized three years ago, were extremely popular until last year's spot fuel shortages and unsettling world events shifted the market downward to smaller models almost overnight. But they've continued to sell well compared to other autos above the compact-size category. The 1981 changes should enhance their popularity and retain their leadership position in the "medium specialty" class.

GM's A-specials are the Chevrolet Monte Carlo, the Pontiac Grand Prix, the Buick Regal and

(Please turn to page 171)

Pontiac Phoenix (top) offers air dam and spoiler as part of SJ package. Two-tone paint is a delete option. Bonneville Brougham (middle) has a 3.8-liter V6 as the standard engine, with the 4.3-liter V6 optional. Restyled Cutlass Supreme (right) offers a 5.7-liter diesel V8.



Chevy Caprice's fuel economy improves with aerodynamic restyling, high-pressure radials and computer-controlled lockup torque converter.

# Driving the Ford, Mercury and Lincoln models

by Michael Lamm WEST COAST EDITOR

DETROIT  
'81



A couple of fresh faces in the lineup should brighten Ford's outlook for the future.

The Lincoln Continental has changed little from last year's model. New features include optional self-sealing tires, a wider choice of colors, higher trim level and a small improvement in fuel economy.





The three-door Lynx (below) and five-door Escort (right) share the same platform and major mechanical pieces. They are front-wheel drive, have independent four-wheel suspension and will get over 40 mpg.



The Escort/Lynx 1.3-liter engine (1.6-liter optional) is transversely mounted and features an overhead cam, hemispherical cylinder head and hydraulic lash adjusters. The dash layout (right) is excellent and readable. All vital controls are handy.

**H**ot news from the Ford Motor Co. for 1981 centers on its high-mpg "Erika" front-drive subcompacts. There's also a totally redone set of replacements for the Granada and Monarch, but let's talk first about the new mini-cars.

Ford used the code name "Erika" while developing its long-awaited World Car. Now that it's here, the Ford Div. version takes the name Escort: it's the car that replaces the Pinto. Yet the Escort and Pinto share nary a nut or bolt, despite the

Escort's 95-percent U.S. manufacturing content.

Lincoln-Mercury offers its own rendition—visibly upgraded—called the Lynx. The Lynx supersedes the Mercury Bobcat and is also 95-percent American-made.

Both nameplates come in two body styles, with two engines and two transmissions available. For 1981, Escorts and Lynxes are offered as three-door hatchback coupes and five-door wagons only.

The base engine is a 1.3-liter,

(Please turn to page 176)



The standard engine for this year's restyled Granada is the 2.3-liter Four. Overall, the lines have been rounded to improve the aerodynamics and reduce fuel consumption.

F-M photos: Robert Lamm

**DETROIT**  
**'81**

# Driving the Dodge, Chrysler and Plymouth models



by Gary Witzenburg  
DETROIT AUTO EDITOR

New this year for the Dodge Omni is an optional 2.2-liter, Chrysler-built Four. It shares this engine with Chrysler's all-new K-cars, Aries and Reliant.

**L**ast month, we covered the all-new front-drive Plymouth Reliant and Dodge Aries: two feet shorter, 800 to 1000 pounds lighter and 25 to 33 percent more fuel efficient than the outdated Volare and Aspen they replace. They are worthy competition for General Motors' popular X-body cars and will be Chrysler's "bread-and-butter" entries for 1981. This report examines the remainder of the company's '81 lineup, especially its latest image booster, Imperial.

The new Imperial represents the

ultimate development of Chrysler's mid-size, conventional-drive platform, which also supports the LeBaron/Diplomat sedans and wagons and the Cordoba/Mirada personal coupes. It is the first car to bear that once-presitigious name since the old full-size Imperial was discontinued four years ago.

Besides its eye-catching styling, the '81 Imperial is most notable for its all-electronic engine control and instrument panel, its "one-price" marketing strategy, and the extensive program to ensure the car's ex-

ceptionally high quality control.

First, the styling. We think the front end is stunning, bold, sensuous and distinctively simple all at once. In profile, the car's lines are fairly conventional, crisp and squared-off from front fender to rear pillar. But then they swoop from roof to rear bumper to accentuate a Cadillac Seville-like "classic" trunk bustle—the design for which was in clay a year before the Seville was introduced.

Offered in a single body style, a

*(Please turn to page 172)*



Dodge Diplomat remains virtually unchanged for 1981. Minor engineering modifications have increased mileage and reduced weight.



Dodge Challenger, built by Mitsubishi, receives new sheet metal for '81. It also benefits from more interior room and a revised instrument panel.



The Plymouth Turismo TC-3 benefits from revised interior appointments and a wider choice of colors and trim options.



Chrysler's new flagship, the Imperial (below), sports a complete electronic dash and a super-plush interior. Sloped nose, clean lines and a bustle trunk will certainly help to set this car apart from the crowd.



**DETROIT  
'81**

# Driving the new AMC models

by Gary Witzenburg DETROIT AUTO EDITOR

Jeep CJ-7 (right) and CJ-5 have 2.5-liter, four-cylinder engine and manual transmission as standard equipment. Part-time 4wd is standard on CJs.



Concord wagons and sedans receive a wider choice of options for '81 such as styled wheels and Goodyear Arriva radials. They also will display a new grille and rectangular headlights.



Renault R5 gets a rear-window defogger as standard equipment. This was previously an option. The 40+ mpg Le Car options include steel-belted radials, reclining seats and power-assist brakes.



Spirit can come plain or fancy all the way up to the GT package. It includes rally suspension, leather steering wheel, spoiler and styled wheels.



**T**he biggest news for 1981 at American Motors is the addition of the smaller, Spirit-based four-wheel-drives to the expanding Eagle line. The sporty SX/4 liftback and utilitarian Kammback are both powered by the thrifty (Pontiac-built) 2.5-liter, four-cylinder engine with four-speed manual transmission as standard equipment. This should give AMC sales people a 20-mpg (EPA city) Eagle to brag about and will do much to enhance Eagle's reputation as a relatively fuel-thrifty 4wd.

Second in the news department is the sharp, new front-wheel-drive Renault 18i, in sport sedan and wagon variations. The 18i offers a very economical 1.6-liter, fuel-injected Four in attractive and comfortable family-sized packages.

Also new is a redesigned 4.2-liter, six-cylinder engine. It's 90 pounds lighter, smoother, quieter, more fuel efficient and requires less maintenance, yet gives equal or better performance compared to last year's Six. Slaving excess metal from the engine block provided a 30-pound reduction. The cylinder head is 12 pounds lighter, a new glass-filled nylon valve cover saves 19 pounds, and

*(Please turn to page 180)*



# Driving Mazda's new fwd GLC

A new engine, front-wheel drive and lively performance make this good little car a great little car.

by Gary Witzenburg  
DETROIT AUTO EDITOR

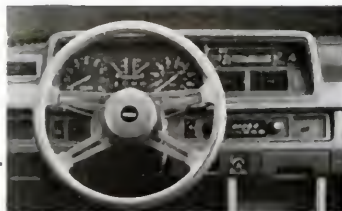
Clever rear suspension of GLC allows the outside tire to toe-in during hard cornering.



The original Mazda GLC was launched in early 1977 when the ads stressed that this was a "piston"-engined car. You'll recall that the rotary engines in the RX-2 and RX-3 were accused of durability and fuel consumption problems. The GLC was made available to keep showrooms stocked while rotary engine problems were ironed out.

As the models were improved and expanded, GLC sales increased. Together with the exciting RX-7 sports car and the excellent 626 coupe and sedan, the GLC helped boost Mazda to fourth place in U.S. import sales behind Toyota, Datsun and Honda. For 1981, the GLC, always a "Good Little Car," finally achieves true greatness, fully competitive with the best of the econobox field.

Toyo Kogyo engineers designed a lighter and more compact version of the small Mazda four-cylinder engine, upped its displacement, power and torque a bit, turned it sideways and coupled it to an all-new, highly efficient front-drive power train. Wheelbase was stretched 2 inches for better ride and roominess, front and rear tracks increased for han-



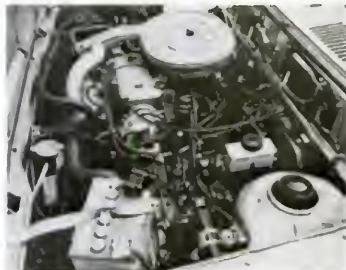
Dash layout puts all of the vital functions within very easy reach of the driver.

dling and stability, and new, fully independent front and rear suspensions designed with low-friction shock struts, variable-rate coil springs and antisway bars at all four corners.

Twin transverse links in the suspension eliminate rear-wheel tendency to toe-out during cornering, and a double proportioning valve in the diagonally split disc/drum power-brake system stops dangerous rear wheel lock-up under hard braking.

Well-isolated, low-friction rack-and-pinion steering provides quick, predictable, low-effort response

(Please turn to page 182)



Transverse-mounted Four has a 1500-cc displacement and yields over 40 mpg.



Split rear seats fold down to provide a wide and flat cargo section for luggage.

The new GLC version has crisp styling, is fun to drive and extremely well finished.



Supple suspension soaks up bumps admirably on Mazda's rough-road test course.





Freestanding fireplace, though not as efficient as stove, is cheery, easy to install. This El Fuego unit supplies heated air through vents.

# Space heaters: How to choose from 31 types

Zone heating can conserve energy, save you money and put warmth exactly where you want it, when you want it. Here's how to tell which heater is best for you.

by John H. Ingersoll

**G**eorge Washington warmed his Virginia home with "zoned heat"—or, more simply, fireplaces. Since then, we've come a long way—at least until recently. Up to 1973, we basked in the luxury of controlled comfort from marvelously efficient, conveniently automatic, rel-

atively economical central heating systems—the product of modern technology.

Then the crunch came.

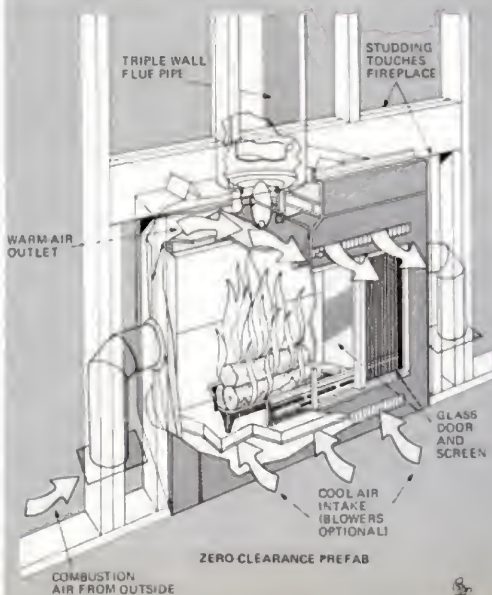
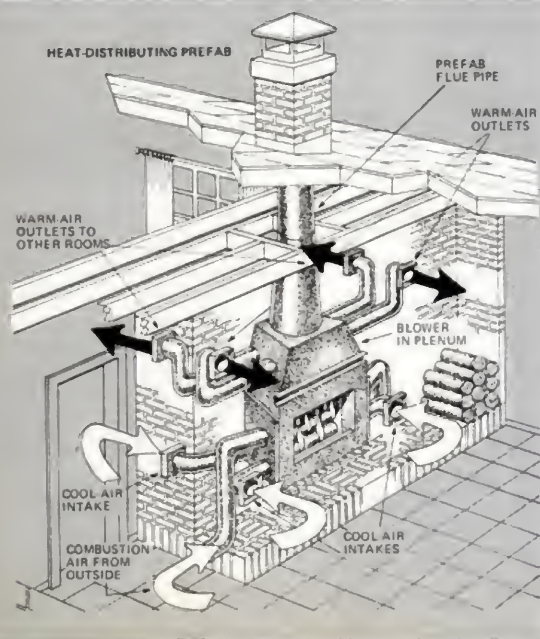
Today, we're relearning some old truths. The "primitive" heaters of Washington's time no longer seem so crude—in fact, they make a lot of

sense. What we're rediscovering now is that zoned heat can save energy and cut fuel bills by reducing the workload on the central system and supplying heat only when and where it is needed most—without costly and unnecessary waste.

What's more, zone heaters—or

## Prefab fireplaces make installation easy

Self-contained prefab fireplaces circulate heated air through double-wall metal enclosure, are more efficient than open masonry type and come as complete, ready-to-install units. Zero-clearance Preway model (photo at right, drawing at lower right) can be built flush into a combustible wall without surrounding masonry. It draws in air for combustion from outside the house and has optional blowers to boost heat circulation. If space doesn't permit mounting in a wall, it can be installed in a corner of a room with simple stud framing around it. Heat-distributing fireplace (left, below) is one of newest types, works like a small warm-air furnace. Blower in plenum above firebox directs heated air to several rooms at once through system of furnace-like ducts. Arrangement shown here is for Octa-Therm fireplace sold by Martin Industries. Like Preway model, it also draws combustion air in from outside the house. This helps to prevent the loss of room heat that would normally be drawn up the chimney flue.



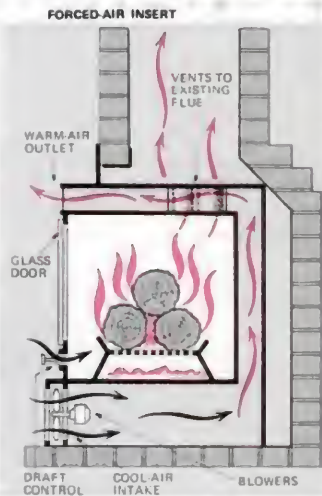
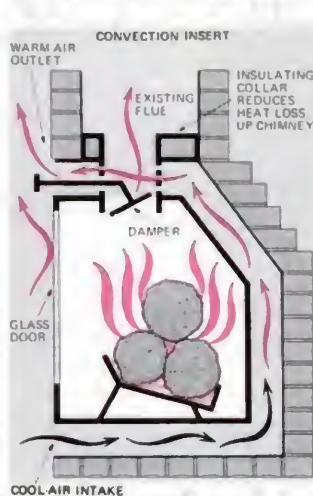


"space heaters," as they have been more popularly known in the past—make it possible to tailor the heat source to your individual tastes and requirements.

Wood and coal stoves give a cheery warmth and sense of good fellowship that are hard to get from a furnace in the cellar. Prefab fireplaces make it relatively easy to enjoy the pleasures of a roaring fire in virtually any room. Trimly styled electric, gas, oil and kerosene heaters come on quickly and shut down instantly, putting out heat only for as long as it's required. Portable units can be used anywhere and are handy for carrying from room to room.

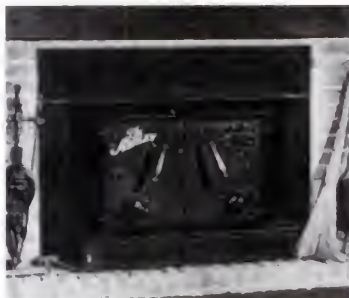
The concept of creating a special "warm room" in the house—a place where the whole family can congregate for pleasant activities over the long winter months—is fast becoming a new American way of life. The traditional British practice of maintaining cool bedchambers, where little heat is needed for comfortable sleeping, is also catching on. Zone heaters lend themselves perfectly to these trends. Moreover, many are "blackout-proof," continuing to pump out welcome warmth even

## Update a fireplace with a slip-in insert



Modern fireplace inserts fit into an existing fireplace to reduce waste heat and improve efficiency. Cool room air is drawn in at bottom, heated as it circulates around firebox in a double-wall enclosure, then flows back into room instead of up chimney. Inserts come in two types. Natural-flow heaters,

such as this El Fuego model (photo at top, drawing at left), circulate air by convection. Forced-air heaters, like Bennett-Ireland (drawing, right), have built-in blowers to aid circulation, are somewhat more expensive. Both types have adjustable draft controls easily accessible from the front.



You can even mount a wood stove in an existing fireplace. This Ashley insert from Martin has double-wall construction and electric blower to circulate heated air.

## Four types of radiant wood stoves

Airtight stoves like Jotul from Kristla Associates (far left) are rated tops in wood-burning efficiency, come in many styles. Crest model (far right), from Washington Stove

Works, is a combination fireplace/stove that functions as an airtight when doors are closed. At center are traditional Franklin-style stove (left) and potbelly (right). These

have rustic charm, are generally less expensive, but don't feature airtight construction. Like the Crest, the Franklin style serves as a fireplace with its doors open.



## Take your choice of wood, coal or gas



Modern-style circulator stoves have double-wall enclosures that heat air as it flows around firebox. Some offer optional blowers to increase circulation. Models shown



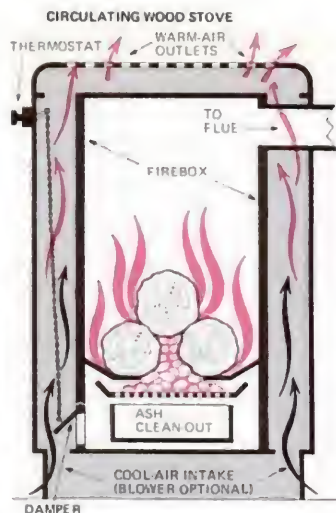
here, Martin (left) and U.S. Stove (right), both burn wood and coal, also come in wood-only versions. Both have cooking surfaces under removable or lift-up tops.



Gas-fired heaters come in two types, vented (left) and unvented (right). Unvented units, now approved by AGA, need



no flue, can go anywhere. These Martin models combine radiant heat with natural or forced-air circulation (blowers extra).



when winter storms down power lines.

Surprisingly, when you add up all the wood, coal, gas, oil, electric and kerosene heaters that exist, and all the varied forms they come in, you'll find at least 31 different kinds to choose from. To help you buy, PM has compiled data on these in two charts—one for wood-burning stoves and fireplaces and another for electric, gas, oil and kerosene heaters. You'll also find information on multifuel furnaces and furnace add-ons that can conserve your regular fuel.

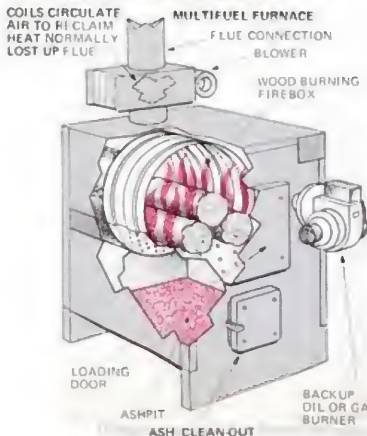
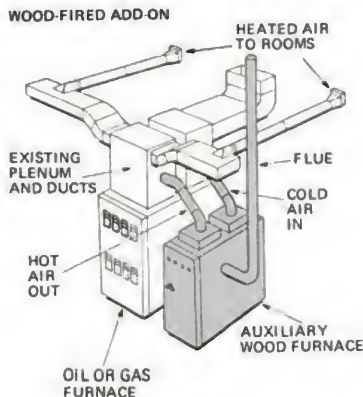
Which is best for you? This depends on what you want to use it for, where it will be located, how much

## How to have a furnace that burns anything

Wood-burning add-on furnace can be hooked into any central hot-air system to supply supplementary heat. Heated air is fed into plenum for distribution through ex-

isting ducts. Regular gas or oil burner provides automatic backup, coming on only if needed. This Ashley model can also be installed as central wood furnace by itself.

Central wood-burning furnace has backup gas or oil burner that comes on if fire burns low or you're away from home. This Longwood Dualfuel system can be connected to new or existing hot-air ducts. Coils help reclaim heat normally lost up flue.





heat it must produce, how often and for how long it will be operated, and how much you'll have to pay to fuel it in your area.

### How efficiencies compare

While a heater's rated efficiency is important to know, buying on the basis of efficiency alone can be mis-

leading—as we'll see. Also, don't confuse efficiency with output—they aren't the same thing. A high-efficiency heater may actually put out less room heat than one of lower efficiency but greater capacity. You need to consider both figures to shop wisely.

The efficiency ranges listed in the

charts represent the percentage of usable heat extracted by a given type of heater from the available heat contained in a given type of fuel.

A pound of dry oak, for example, contains 8600 B.T.U. of *potential* heat. (B.T.U. stands for British

*(Please turn to page 204)*

### Portable heaters you can use anywhere



Portable electric and kerosene heaters put out 2000 to 17,000 B.T.U./hr., are handy for carrying to any room. Kingston (top center) is typical of electric floor models. Krups two-way electric (above) can mount on wall or floor stand, has timer control. Kerosene heaters like this Aladdin model (top right) come in many styles and sizes.



### HOW ZONE HEATERS COMPARE

	Type of Heater	Rated B.T.U./Hr.*	Efficiency	Vented	Blower	Price Range**
Gas	Circulating floor model	15,000 to 70,000 (I)	80%	Yes	Yes	\$175-\$450
	Gravity/radiant floor model	15,000 to 40,000 (I)	80%	No	No	\$90-\$200
	Circulating/radiant floor model	35,000 to 70,000 (I)	80%	Yes	Yes	\$250-\$550
	Circulating built-in wall model	15,000 to 70,000 (I)	80%	Yes	Yes	\$250-\$425
	Counterflow vertical wall model	17,500 to 48,750 (O)	80%	Yes	Yes	\$175-\$550
	Gas logs	40,000 to 50,000 (I)	10%	Through existing flue	No	\$150-\$550
	Circulating floor model	38,000 to 65,000 (O)	70%	Yes	Yes	\$195-\$525
	Convection floor model	38,000 to 50,000 (O)	70%	Yes	No	\$125-\$275
Oil	Circulating built-in wall model	60,000 to 70,000 (O)	70%	Yes	Yes	\$650-\$950
	Baseboard convactor	1280 to 8530 (O)	100%	No	No	\$8-\$16/ft.
	Circulating wall model	2559 to 16,832 (O)	100%	No	Yes	\$50-\$190
	Circulating ceiling model	4080 to 5120 (O)	100%	No	Yes	\$45-\$85
	Radiant wall model	2559 to 10,240 (O)	100%	No	No	\$30-\$100
	Radiant ceiling model	1706 to 3400 (O)	100%	No	No	\$35-\$75
	Circulating kickspace model	1706 to 6826 (O)	100%	No	Yes	\$75-\$125
	Electric fireplace	5120 to 10,290 (O)	100%	No	No	\$125-\$500
Electric	Portable baseboard convactor	1700 to 5120 (O)	100%	No	No	\$45-\$75
	Portable circulator	3413 to 17,060 (O)	100%	No	Yes	\$30-\$100
	Portable radiant	3410 to 5120 (O)	100%	No	No	\$25-\$125
	Portable radiant	7200 to 12,500 (O)	70%	No	No	\$35-\$250
Kerosene	Open masonry fireplace	-10 to 10	\$1500-\$3000			
	Masonry fireplace with glass screen	-10 to 5	Screen: \$50 to \$175			
	Prefabricated zero-clearance fireplace	-10 to 10	\$350-\$600			
	Prefabricated fireplace with natural or forced-air circulation and optional outside combustion air	10 to 30	\$450-\$1000			
	Freestanding fireplace	-10 to 20	\$200-\$700			
	Franklin-style stove	20 to 40	\$150-\$600			
	Potbelly, box and other radiant stoves	30 to 45	\$125-\$200			
	Circulator stoves	40 to 55	\$250-\$475			
Kerosene	Airtight stoves	50 to 70	\$300-\$1300			
	Fireplace inserts	Variable, see text	\$450-\$1000			
	Central wood furnaces	40 to 60	\$1200-\$2250			

\*See text for explanation of efficiency ratings.

\*\*Prices do not include installation except for a traditionally constructed open masonry fireplace.

(I) indicates input rating; (O), output rating. Output is the more meaningful figure since it tells what a heater actually delivers. Some units are listed only by input. Output is roughly 70% input.

\*\*Prices do not include installation cost in cases where installation is required.

# How to saw firewood on the double







Depending on the amount of wood you cut for the heating season, the almost-forgotten handsaw may be the way to go.

by Doug Newman

**O**ne- and two-man crosscut saws will never replace the chain saw for most of us—even if gasoline goes to \$3 a gallon. For some, however, it provides a sensible alternative. The trick is that you should spread out your wood-cutting chore over two or three dozen hour-long stints—instead of two or three all-day marathon sessions with a chain saw.

There are several bonuses, not the least of which is that it's more healthful. In an age of paying money to keep in shape, a crosscut saw is a cheap and productive way to get exercise. The saw shouldn't cost you much more than a couple of hours of tennis-court time, or the price of new running shoes. It won't numb your arms or ears with intense vibrations and noise, the way prolonged use of a chain saw will.

The crosscut saw is cheaper and less messy. There's no worry about mixing gasoline and oil. And it will always "start."

If you want to buy a saw, here are some pointers:

- Two types of basic blades are available—one-man and two-man crosscut saws.

- A one-man saw is asymmetrical and features a conventional saw handle at the wide end of the blade. An auxiliary handle can be attached to the small end of the blade to allow two people to work the saw. One-man saws, once produced in lengths from 3 to 6 ft., are available today in 3-, 3½- and 4½-ft. lengths.

- Two-man saws are symmetrical and have a handle at each end. Two types exist—the felling saw for dropping timber and the bucksaw for cutting the dropped tree into shorter lengths. A felling saw has a narrower blade and a concave back. It is lighter than a bucksaw and more flexible. Bucksaws come with a straight back and are thicker, stiffer and heavier than felling saws. The weight

Two-man felling saw builds teamwork, muscles, good wind—and it doesn't disturb the woodland peace and quiet.





Crosscut saws are available in one- and two-man types. With addition of an auxiliary handle (left), two men can work one-man saw.



is desirable, since it helps the teeth bite deeper and speeds cutting. Stiffness allows the saw to be run by one person.

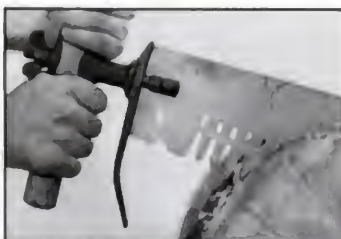
While many felling saws and buck-saws are still around, some modern blades have characteristics of both types and could be called utility saws. They work well on many jobs.

Today, long crosscut saws are available, but not everywhere. They were once produced by several large companies, but now only one U.S. firm—Jemco Tool Corp., Seneca Falls, N.Y.—makes them. A typical 6-ft. saw costs \$57, with one pair of handles. A 42-in. one-man crosscut saw with auxiliary handle is \$35.

If your local hardware store doesn't stock saws and can't order



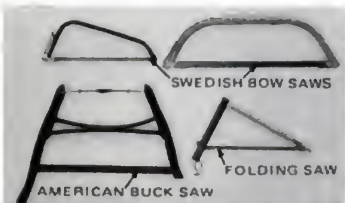
Saw patterns, although they vary, fall into two classes: felling and bucking. Former has curved back, latter is straight.



Old-style saw handles, often seen at auctions and flea markets, have rugged finger guards to prevent jammed fingers.



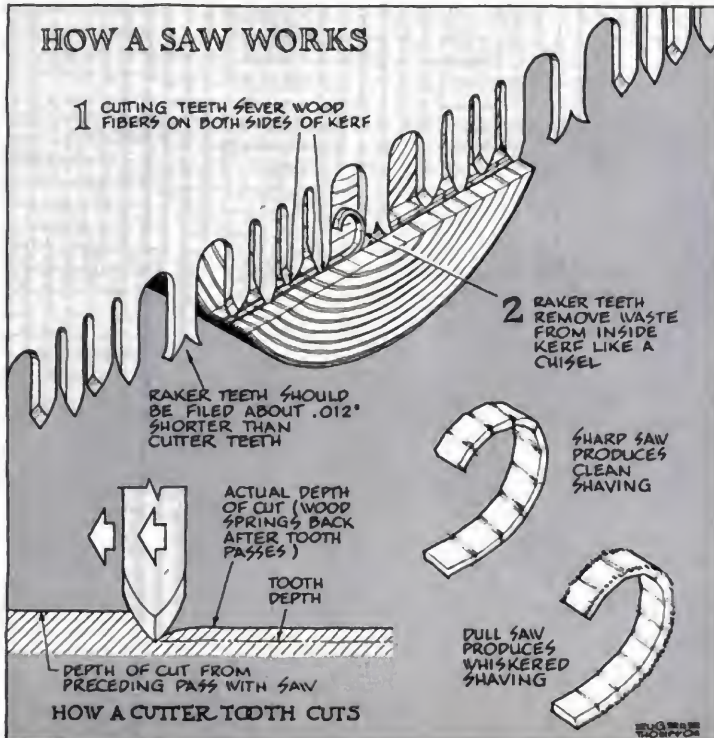
Another desirable feature is adjustable handles that let the grip rotate 90°. This is handy for avoiding obstacles.



Small-size crosscut saws (above), which are handy for the cutting of small-diameter logs, are equipped with replaceable blades. The folding types are especially handy for the use of backpackers (below).



## HOW A SAW WORKS





what you want, write to the Crosscut Saw Co., 2 Leland Dr., Seneca Falls, N.Y. 13148, for a catalog and price list.

If you can find them there, hand-saws are least expensive at second-hand stores, garage sales, surplus stores and flea markets. Prices range from \$10 to \$60 for a used two-man saw, based on blade length, condition and whether it is sold with handles. The price goes up if the seller thinks it's an antique.

Avoid saws with pitted and rusty blades. Check a blade carefully—look for broken teeth, kinks or other signs that it has been roughly treated. If possible, look at several different saws before you buy, so you can recognize basic characteristics.

On many crosscut saws, a common tooth pattern features four cutter teeth to each raker tooth. The tooth lengths vary between brands; excessively short teeth may indicate the blade has been filed many times and is almost worn out.

### Handling a crosscut saw

While crosscut saws are safer than chain saws, several items should be remembered when using the blades. First, make a blade guard. A piece of fire hose or heavy canvas and large rubber bands cut from old inner tubes work nicely. Keep the blade covered until you reach the work site.

In a vehicle, remove the guard and sandwich the blade between two plywood strips. This keeps the teeth

from punching through the hose and dulling against metal. Bolts and wingnuts secure the package.

Before you begin sawing, clear the area around the cutting site so the saw won't hang up on limbs or underbrush. Remove any bark at the point of cutting. Bark often contains dirt and grit that will dull teeth or jam the blade in the cut.

Evaluate potential safety problems before you start. Will a log shift or roll once you cut it through? Will a bent tree spring loose, once some weight is cut free? Are you on a hill? Cutting standing timber is particularly hazardous and should only be attempted in the company of an experienced woodsman.

Once the cut is started, remember

*(Please turn to page 185)*

## HOW TO FELL A TREE WITH A TWO-MAN SAW

The first time I ventured into a woodlot with a two-man saw, it took two hours, a lot of head scratching and a good push to fell my first tree. As a member of the chain-saw generation, I had no idea of what to expect from my two-man saw—and more important, what my saw expected of me. I've learned a lot since. Here are tips for anyone gung-ho enough to want fell a tree with a crosscut saw.

1. If you've bought a new saw, don't assume it's ready to use. A factory grinding wheel used to sharpen the teeth often leaves burrs that need smoothing with a crosscut file.

2. Know the type wood (hard, soft, green, punky and so on) you'll be cutting so you can prepare your saw properly at home. It's hard to change the set on site.

3. If you have no experience in judging which is the best direction to fell a tree, bring along someone who does.

4. Besides the saw, bring a hatchet for clearing underbrush from the working area, kerosene for lubricating the blade, an ax for completing felling notches, workgloves and a file and setting device in case teeth should need touching up. Finally, if possible, bring a sawbuck for cutting logs into manageable lengths.—Joseph R. Provey



To drop a tree, cut notch in direction of fall. Use saw for undercut  $\frac{1}{2}$  diameter of tree and ax to chop out a 30° notch.



Back cut (on opposite side from notch) is made 1 to 2 in. above undercut level. Leave 2-in. portion (hinge) uncut.



Prior to making either cut, chip away bark with a hatchet. Dirt and bark itself, might otherwise dull saw quickly.



If saw binds while cutting, drive wedges as needed to free blade and continue sawing. Plastic wedges won't damage saw.



Be certain escape path is clear of obstacles before you start cutting tree. Best angles of departure are 45° from the line of fall.



Once tree is on the ground, use sawbuck and one- or two-man buck saw to cut log into desired lengths. Remove bark at cut.

# KITCHEN REMODELING

## This chef built it all . . . including the cabinets

The contractor wanted \$20,000 to redo this kitchen. The owner saved \$14,000 by doing it himself.

**W**hen Mr. and Mrs. Paul Levine of Sherman, Conn., decided to remodel their old kitchen, they had a contractor prepare an estimate of the cost for the complete job. Their initial reaction to the price was "almost a state of shock" according to Paul. "What I thought was a rip-off turned out to be the high cost of materials and labor," he added.

Since he felt he could build the kitchen for a small fraction of the contractor's price, he worked up his own estimate of the cost for all the materials, as well as allowing for some professional help. To this he added "the cost of jobs I could not do myself and would have to farm out." This figure turned out

to be less than half the original bill.

Unless you are well versed in cabinet construction and kitchen layout, it's a good idea to consult with a professional designer before you start your remodeling project. Since even a do-it-yourself kitchen involves considerable cash outlay, it makes no sense to put in the ef-



**1.** Existing closet became a contemporary "hutch" with recessed light above, glass shelves on wall, cabinets below.



**2.** Recessed cedar ceiling pattern is repeated at hutch and on cabinets.



**3.** Cookbook rack, built into an otherwise wasted corner, makes it easy to locate a favorite recipe quickly.

**4.** Lots of shop-built cabinets and counters leave tabletop free for eating.

4





Kitchen design: Martin Bloomenthal, A.I.A.  
PM photos: George Ancona  
Technical art: Eugene Thompson







fort and end up with a product that doesn't function properly or isn't appealing.

The work in Levine's kitchen began with the removal of all the old cabinets, existing plumbing fixtures and the old plasterboard. Though it's messy, removal of the plasterboard gives ready access to wiring and permits the addition of insulation to outside walls. Old doors and single-pane windows were removed.

With all the demolition complete and debris removed, the outside wall was immediately closed in to the weather by framing openings and installing new windows and doors.

Framing for special features like the hutch alcove and the sloped ceiling with soffit came next. At this time, all of the electrical wiring, rough plumbing and insulation was done. An outside vent for the stove was also installed. Plasterboard went on last, was taped and allowed to dry thoroughly before priming and painting.

Floor tiles were installed using mastic and epoxy grouting. This job was farmed out. If you lay the tile yourself, you can save even more money. The peripheral floor area, under the counters, was brought up to level with 1/2-in. plywood.

The oak floor inset was installed with a 3/4-in., cork-filled expansion gap at the edges. A 3-in. portable belt sander was adequate for sanding this small area. A finishing sander brought the floor to a smooth surface before the floor was varnished.



**Note:** If there is a difference in thickness between the wood floor and the tile floor, you will have to compensate for it with a layer of plywood before you begin.

### Building the lower cabinets

Begin the base cabinets by determining the overall cabinet dimensions and then cutting parts to suit. Glue the back panel and grooved rails together first. Then cut the top rails and a cabinet bottom of the same length. Edge the 3/4-in. plywood bottom with solid mahogany strips to protect the plywood edges

Good-quality drawer slides and cabinet-door hinges are essential for a smooth functioning kitchen. Flexible rubber drawer pulls (see source list) prevent bumps and bruises when kids collide with them.

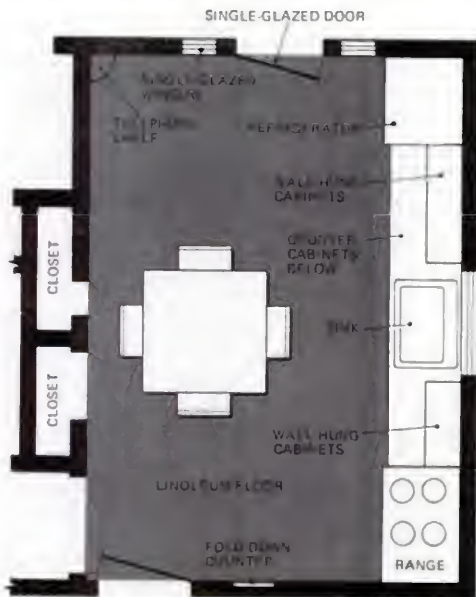


and improve the appearance. Make the cabinet sides from 3/4-in. plywood next, routing for the back, bottom and rails as shown in the drawing on page 112.

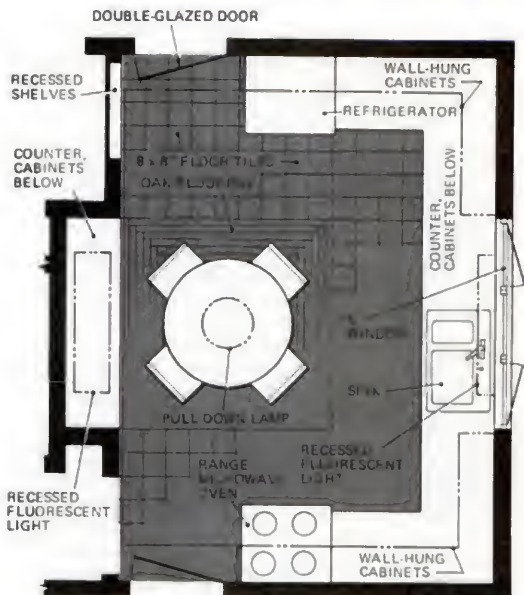
When you are assembling the cabinet, it will square itself if the pieces have been cut correctly. But, it is advisable to check for square while gluing. With all cabinets in place, shim so that the tops form one continuous level line against the walls. Secure the units to the walls with hefty, long screws through the rails and into the studs. Fasten the units together with screws through the sides.

The countertop was made in four sections. Laminate the front edges first, then the top. It's a good idea to also laminate the underside to re-

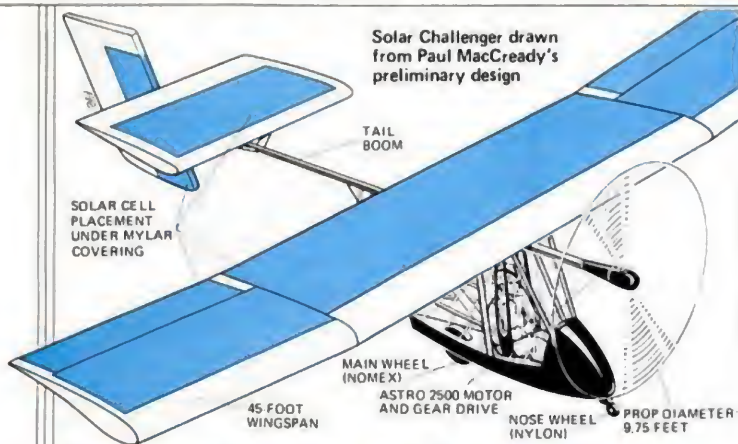
*(Please turn to page 202)*



FLOOR PLAN, BEFORE



FLOOR PLAN, AFTER



## AVIATION

### Now: true solar planes

Janice Brown, 32, is a qualified commercial pilot and first-grade teacher. Unusual, but not as much as becoming prime candidate to fly a solar-powered airplane (SPA) from San Diego to Los Angeles—maybe Paris to London. Nor as curious as being checked out for these sunny odysseys by a 13-year-old test pilot and by Bryan Allen, whose last public aeronautical feat was pedaling across the English Channel.

When it comes to such bizarre aviation happenings, you might suspect correctly that Dr. Paul B. MacCready Jr. is up to new tricks. Having engineered two spectacularly successful human-powered airplanes (HPAs), *Gossamer Condor* and *Gossamer Albatross* (*Engineering a Manpowered Triumph*, page 109, Oct. '79), he and a youthful team have now taken up solar flight.

They aren't alone. Two other SPAs have flown in England and California, NASA is analyzing



MacCready team members: Bryan Allen, Janice Brown (left) and Marshall.

Color photos © Don Monroe



A first for the Penguin: Batteries removed, tow-launched plane carries Marshall MacCready solely on sun power.



related projects and at least one major aerospace firm has conducted private research.

MacCready's third-generation HPA, Gossamer Penguin, was metamorphosed this March into an SPA for its day in the sun. To minimize wing loading, MacCready's 82-pound son Marshall was recruited as pilot, at age 13. It was his "first real flying experience," says Dad, but Marshall already had "mastered unicycles and skateboards."

Flying under battery power, pilot and Penguin proved themselves quickly. Then, in May, a 5 by 10-foot solar panel was placed in an unlikely position high over the fuselage (with no control problem). Penguin's battery pack was removed. And Marshall flew a few feet up for just over a minute, purely on direct solar-cell power—a first—after a human-tow launch. Janice Brown repeated the accomplishment in July, and a several-mile flight by August was planned.

## Tough Challenger

MacCready's new Solar Challenger was taking shape as we went to press, backed with Dupont funding and materials to the tune of roughly \$400,000, including a European expedition. Unlike the truly "gossamer" Gossamer series, it is strong enough to cruise at 3000 to 10,000 feet.

As you read this, the world's first long-duration SPA flights may be happening. MacCready predicts his design "should be capable of several hundred miles."

The Challenger's appearance is more conventional than the Gossamer's. A key problem was placing more than 200 sq. ft. of solar cells. Besides taking up most of the 45-foot wing, they will be attached to an enormous horizontal tail surface.

Empty weight should be just twice that of the Gossamer's; yet 47 of its 124 pounds are solar cells—leaving only 77 for structure, power system and pilot accommodation.

With gross weight limited to 230 pounds, there's no room for batteries, nor pilots over 100 pounds. Thus a search for qualified women, and the choice of Janice Brown. She already has

acquired MacCready's fanaticism for eliminating weight, and cut her hair.

The spar and main wheel cores are of Nomex (Aramid paper) honeycomb, nine times stiffer than steel by unit weight. Most of the structure is made of laid-up Kevlar cloth, a fiber also lighter than steel for equal strength.

The Penguin utilized a model-airplane electric motor weighing only 14 ounces, pushing about 150 pounds of aircraft and pilot at 15 mph with less than ¼ hp.

The Challenger needs about 3 hp for a 35-mph cruising speed and a 180-foot-per-minute climb rate. "Regular electric motors are much too heavy," says MacCready. So Bob Boucher of Astro Flight in Venice, Calif. created a custom 5-pound unit. It and a Kevlar/Delrin belt-drive-reduction system are located inside the bulbous hub of the 5½-foot propeller, at the front of a boom over the pilot's head.

Above the English Channel, between Paris and London, the

June sun at high noon beams about 83 watts of energy upon a square foot of horizontal surface, if no clouds or smog interfere.

However, solar cells are only about 14.5-percent efficient at converting light to electricity. And the motor and drive system are around 85-percent efficient. Thus, the Challenger could realize but 1.8-kilowatts (2.5-hp) best shaft output, though its cells would receive 16.8 kw. (22.5 hp). Even less will be available during most of a day's flight, but that's all that will be needed.

"I have such enthusiasm for where solar cells are going to be in five years," MacCready says. "There's no law of physics that says they've got to be expensive."

Not that he sees recreational SPAs as being viable any time soon. Even the Challenger's cells, rejects on loan from NASA, are worth about \$35,000 to \$50,000 today. For now we'll just have to fly vicariously with Janice Brown out on her silent, solar soaring saga. **PM**

## Who was first?

Three claims have been made for first piloted solar-powered airplane (SPA). Larry Mauro with his Solar Riser in April 1979, at Rubidoux, Calif., was first to fly publicly.



MacCready

This news caused Fred To to break secrecy about his Solar One in England. He reported a very brief documented flight the previous December, then performed publicly that June. In May and July, this year, Paul MacCready's Gossamer Penguin performed.

Both Solar Riser, a converted tailless biplane hang glider, and Solar One, a 68-foot-wingspan sailplane-like design, self-launched and achieved distances under a mile, and altitudes of more than 40 feet. They used onboard NiCad batteries, charged beforehand from their solar panel, for about 75 percent of inflight energy. The balance came from the cells directly.

"By that standard," says MacCready, "I could precharge batteries from a wall socket and claim

the first waterfall-powered aircraft."

Gossamer Penguin only skimmed the ground briefly after human-tow launches, but flew entirely without batteries.

For now, MacCready's new Solar Challenger appears unchallenged for the ultimate SPA first—long solar-sustained flight.



Batteries assist flight of Solar 1.

Photo by Don Monroe



Converted hang glider: Solar Riser.

## ENERGY

### Fuel from sawdust

The steel tower looms 85 feet over the Atlanta campus, a strange sentinel commanding the gaze of hundreds of mirrors lined up in rows like mechanical spectators at a theater for robots.

It isn't the kind of thing you see on a conventional campus, but this is Georgia Tech, where the tools of science are as much a part of the scene as faded jeans. Though the tower may have a sci-fi look, it's as functional as a gas stove.

In the future, similar units may routinely use the power of the sun to "cook" waste

materials into valuable gas and oil fuels.

The tower and the array of mirrors harness and concentrate the radiant energy of the sun. Together they make a solar furnace, one of only a handful now available to scientists in a young field of research.

Supported by a metal framework, the field of 550 mirrors, called heliostats, stands some six feet off the ground. Each mirror is held by a mount that is mechanically driven by a 1-hp motor to track the sun and beam its rays to a common focus 70 feet up on the tower. There, temperatures surge to about 1500°F. in a fraction of a second, and can be raised as high as 3500°F.

One upcoming experiment here, by Princeton University's Dr. Michael J. Antal, is aimed at

pulling useful products from wood and waste materials.

The heart of his experiment is a transparent quartz tube a couple of inches in diameter and a few feet long.

In a set of upcoming tests, Dr. Antal will inject sawdust from wood and ground corncocks into the quartz reactor, placed at the focal zone. In a flash, the finely ground particles will vaporize.

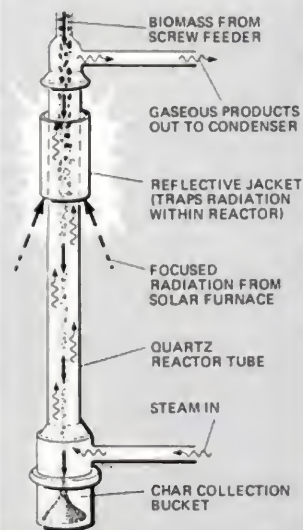
Temperatures higher than 1300°F. are critical to the process, Antal explained. Slow pyrolysis—a chemical change brought about by heat—produces mainly carbon monoxide and hydrogen. But fast pyrolysis results in significant quantities of hydrocarbons called olefins, valuable as feedstocks in the chemical industry and as precursors to gasoline.

"Our work is not, as some people seem to think, something that lies between a Rube Goldberg scheme and a cute trick," Antal told us. "It's not a cute trick that anyone can do. The answers we seek are not simple. We're studying chemistry that's very complex and sophisticated, using knowledge that wasn't even available just a few years ago. And the level of sophistication reflects the growth and promise of science."

PM



A field of 550 mirrors can raise temperatures at a focal zone to 3500° F.



Reactor "cooks" fuel from sawdust.





Blades 42 feet high capture wind.

## Wind reaper

What looks like a farm combine perched on its side is a new kind of windmill, the Giromill, built by McDonnell Douglas.

A prototype under test by the Department of Energy in Rocky Flats, Colo., consists of a 60-foot tower, three 42-foot vertical blades and an electric generator; capacity is about 40 kw., or enough power for 15 homes. Alternatively, Giromill can run irrigation pumps for hundreds of acres of farmland. The unit starts up in winds of 10 to 12 mph and feathers its blades at 40 mph. The design is expected to be cheaper than conventional units; the prototype costs \$1.7 million.

## The electric pipeline

Put this in your pipeline and smoke it: Dr. Henry Liu of the University of Missouri has developed a new way to transport coal via pipeline.

In the past, coal has been sent as a slurry through pipelines, draining local water supplies and requiring costly separation. Liu's plan: Coal or other cargo would be packaged in metal capsules for injection into water-bearing pipe. Magnetic coils would move the capsules.

Liu's capsules might even provide some relief for the overburdened Post Office—although some say that the service is already going down the tubes.

## AUTOMOTIVE

### Fuel cells hit the road

In the 141 years since the first workable fuel cell was built, its finest moments have been in space, supplying electrical power to keep astronauts flying. Now, it appears, the fuel cell is about to start more mundane service: Today, golf carts; tomorrow, your car.

The principle behind fuel cells is simple. It's the reverse of electrolysis, in which electricity is applied to break water into its components, hydrogen and oxygen.

By contrast, in the original fuel cells, hydrogen and oxygen were combined to form water and electricity. Heat and small amounts of electricity were required to get the cell working. Modern fuel cells use different elements. The best energy yield today results from combining oxygen and methanol. The electricity still needed to start the initial cycle is delivered by an on-board battery pack.

### Batteries at rest

Once the fuel cell is producing electricity, the batteries become idle and the vehicle's electric motor is powered solely by the current supplied by the fuel cell. Simultaneously, current is bled from the fuel cell to recharge the

batteries while the vehicle is underway.

So far, the only vehicle tests conducted have been with golf carts, like the prototype below built by the Los Alamos Scientific Laboratory (LASL), a research agency partially funded by U.S. grants. But fuel cells have demonstrated efficiencies high enough to make installation on a compact car feasible. LASL estimates the cost of a fuel cell-powered VW Rabbit at \$7240—cheaper, in fact, than a current gasoline-powered Rabbit. The performance would be comparable to that of a diesel Rabbit, the lab calculates.

Aside from the fact that fuel cells use no petroleum-based products, there are other advantages. The cells require less maintenance than a gas engine. And the only by-product is water.

### Coal: a hot controversy

The burning question: whether to create an entire industry to convert coal to synthetic fuel (synfuel) or simply burn the coal without conversion.

That's the central question Congress has been kicking around in trying to decide whether to allocate \$20 billion for the development of a massive synfuel industry. The plan would lead to a huge hike in coal production and a major refinery-building campaign. Many en-



Fuel cell on a golf cart test-bed has shown great promise for use in cars.

ergy experts see the plan as the only way to keep cars rolling.

But according to some recent findings, converting coal into liquid fuel may not be the most efficient way of exploiting this vast national resource.

Research conducted by Dr. H.G. Mueller of Essen, West Germany, suggests it is more efficient to burn coal to make electricity to run electric cars than to process the coal into fuel to run internal combustion engines.

Mueller argues that a ton of coal burned to make electricity would power an electric vehicle twice as far as that same ton converted to fuel an internal combustion engine.

There are other factors which seem to make burning more appealing. One is that synfuel plants are much more expensive to build than coal-burning electric-generating plants.

Air and land pollution is another problem. Synfuel plants release large amounts of hydrocarbon emissions which foul the air. While coal-fired plants also pollute, they are much easier to keep clean than synfuel plants.

## Don't burn it

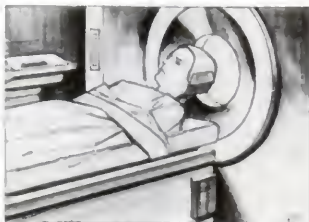
To get the other side of the debate, we called engineers at Dynalectron, a pilot synfuel plant in Kentucky. They told us that the production of liquid fuel from coal is still a relatively new technology.

New methods that will improve efficiency and clean up pollutants should make synfuels more attractive, they argued.

Dynalectron researchers told us the efficiency they achieved in their pilot plant far exceeded their original estimates. And new strides are being made to further increase the efficiency of both the plants and the engines which will eventually use the fuel.

And, while the initial costs of building a synfuel plant may be high, compared to a coal-burning power plant, in the long run the synfuel operation will be cheaper. If the country had started building synfuel plants 10 years ago, they asserted, the price of synfuel today might have been cheaper than refining crude.

## INVENTIONS



Gamma rays help produce 3-D view.

## Nuclear brain scanner

Doctors can get a three-dimensional view of the brain using a new device to detect radiation from a patient's head. They first administer a radioactive preparation to patients. The substance, emitting gamma rays, concentrates in brain tissue. Then the patient is wheeled on a movable couch so his head enters a doughnut-shaped imager where detectors signal a computer to produce an accurate display. Hugh F. Stoddard invented the scanner while he was on the staff of Union Carbide Imaging Systems in Massachusetts. (Patent 4,209,700.) **PM**

## Droplet power

The first windmill with no moving mechanical parts—that's the way Alvin M. Marks, president of the Marks Polarized Corp., New York, describes the invention on which he received a patent.

The only moving parts will be

charged water droplets. When wind blows them away from a screen, which could be as large as 1000 square yards, the charge on the screen changes with respect to the ground. The power to charge the droplets is only a fraction of the electrical power produced by the wind. (Patent 4,208,396.) **PM**

## Wrist radio-watch

A short-range transmitter may someday set your watch automatically, under a method patented by Jerome H. Lemelson, president of Licensing Management Corp., New York. Every time you pass near a master clock with this transmitter—perhaps near your front door—the receiver-watch on your wrist would get in line with the master clock. Sat-



Transmitter corrects time setting.

ellite transmitters, in turn, could keep master clocks on time. Lemelson said his system would be useful for factory or military operations where timing was critical. Airports might also provide time transmitters for travelers. (Patent 4,204,398.) **PM**

Patents may be ordered by number from the Patent and Trademark Office, Washington, D.C. 20231, at 50 cents a copy.



In wind-tunnel model of design, air jet blasts charged drops off screen.



## ELECTRONICS

### Pocket-size computers

First came the slide rule for portable calculating power. Then that venerable tool was supplanted by the calculator; first by simple, four-function machines, then by today's liquid-crystal-faced scientific wonders.

Soon now, even the most sophisticated of these calculators may be replaced by small, powerful, computers. We took a look at two units, a prototype from Panasonic and a production unit from Sinclair that were both little short of amazing.

#### Wafer-thin keyboard

Sinclair's ZX80 (which we examined in some depth for a few days) features a wafer-thin keyboard coupled to some true computing power. The Panasonic RL-H100 (which we saw demonstrated in prototype) is a modular system of plug-ins that can be expanded to many needs.

The Sinclair ZX80 offers finger-sensitive keys, the same type of switch found on some microwave ovens. They don't move when touched, so a typist could run into a tactile-feedback problem. One compensation is Sinclair's amazing system of macros.

A macro is a word or words which you can enter with just one quick keystroke. The word PRINT, for example, is frequently needed in computer programming. One hit on the "O" key in macro mode will type the word PRINT onto the screen and into your program.

#### Connects to home TV

Right now, the Sinclair has a 4K memory, enough for most applications. It hooks directly to a home TV for display and runs off normal AC voltage with an included adapter.

The ZX80's only problem shows up whenever the display screen fills with output. At that point, it simply stops computing. It can only display a full screen of



Panasonic's RL-H100 (left) and Sinclair's ZX80 easily fit into briefcases.

data or work on the data, not both at once. Sinclair told us they will offer an upgrade soon that will correct this problem. Until then, it is more an annoyance than insurmountable; you can manually get around it.

The good news is that the ZX80 will sell for only \$200. That price seems almost more science fiction than the concept of a pocket computer, but Sinclair assures us it is what they'll go for.

We were able to see Panasonic's RL-H100 for only a few minutes, but were impressed by the quality of engineering.

#### Dial for data

The main unit can act on its own or tie into a larger computer via any telephone. This means that a business that subscribes to a computer network or has a large on-premises main-frame computer could use the RL-H100 as a traveling remote. Salesmen could keep track of inventory on the road. Executives could study up-to-the-second reports. Secretaries could get data updated in the field instantly. Hobbyists could access the Source and Micronet, two networks providing large-computer power to small-computer owners.

Besides this capability, Panasonic will be offering a multitude of plug-in options, all in matching cases—everything from printers to expansion memory.

The full system, with all the peripherals, can hardly be considered pocket-sized any longer: It will just barely fit into a briefcase.

Also, the price is a factor. One of the Panasonic people flipped open a large briefcase with all components tied together. She

pointed at the gleaming, silver array and smilingly asked: "Where else could you get an entire computer for \$1200?" We didn't have the heart to answer her.

True, a comparable system would be larger in size, but then the printer would be more legible; a floppy disc might be added for storage, and so on.

But even at the price, this is a system that will certainly appeal to hundreds of businesses. **PM**

### Zap! You're checkmated

At a Chicago electronics show, a pretty girl leaped out at us and asked, "Do you play chess?"

Bobby Fischer should be so lucky, we thought, nodded yes, and followed her to the display.

A typical computer-generated chessboard and pieces were on a projection TV screen. Each of us had a control to move our pieces. We launched into the Queen's Gambit. She declined to take the pawn and we were off into the midgame.

Suddenly, one of her pawns literally zapped one of ours; the poor devil exploded. Then her queen fired mercilessly on another piece and she scored another kill.

The bloodthirsty lass was demonstrating *Star Chess*, a new version of the game played on a TV in which the pieces can fire as well as move. Pieces fire only in the direction they move; a queen's power is stronger than a bishop's, a bishop's stronger than a pawn. So the rules take on a new dimension.

For information on U.S. suppliers, write Waddington's Videomaster, 36-44 Tabernacle St., London, England EC2A 4DT. The American price? Zap! About \$125. **PM**

Editor: Gurney Williams III

Contributors: Bill Allen, Tony Asensio, Glenn Butash, Stacy V. Jones, John F. Pearson, Tom Sahagian, Neil L. Shapiro

# New scanners deliver action-packed listening

by Roy B. Goshorn

**P**reprogrammed and crystal-less scanners have continued to improve and now bring more action than ever before to the home listener. We first took a look at such scanners in July, '77 (*Computerized Scanners: Action at Your Fingertips*, page 68). Then, it was simply amazing that you no longer needed crystals for each frequency and that some of the better scanners could even search out some active, local channels.

Scanners today have taken giant strides beyond even those amazing capabilities. Memory circuits, all 16,650 public service channels programmed, these features have been joined by expanded service coverage (marine and aircraft, too), as well as truly comprehensive search functions.

Two of the top names in mon-

itor manufacturing have designed brand-new sets preprogrammed with all 2100 police, fire, marine, amateur, mobile telephone, emergency, government, forestry, business and transportation frequencies. With the push of a front-panel button, these new radios will automatically search through every possible channel in your area *that's related to the*

*kind of service you're looking for.*

Yes, these new units do it all. You no longer even need a rough idea of the frequency—just “ask” to listen to police, fire or whatever agency you select.

At least three of these new scanners can also tune the marine and aircraft bands. So if you get tired of listening to the local cops, the push of a button switches the scanner to tune in on ship captains, Coast Guard stations, airlines, or airport control towers.

The Electra Co. of 300 East County Line Rd., Cumberland,





If you don't know where the action is on the public-service frequencies, this new generation of scanners will search it out for you. They're easy to program, and some are even preprogrammed with all the channels that any hobbyist would ever need.

Ind. 46229, has just added the Bearcat-220 and the Bearcat-300 Service Search, second-generation programmable scanners to their already very popular Bearcat-210 and Bearcat-250 line.

The Bearcat-220 looks similar to its 210 and 250 cousins, but adds the flexibility of marine and aircraft reception to its scanning capabilities. Its 20-channel memory bank can be loaded with any frequency from the seven public service bands. With these expanded listening capabilities, the unit sells in the \$350 price class.

Electra's current top-of-the-line model, the Bearcat-300 Service Search, comes preprogrammed with

Programmable scanners, like the Bearcat 220 (top) and Radio Shack's Pro 2001 (below), offer exciting features, such as automatic search. They find the action, then display its exact frequency so you can record and enter it the next time. They offer sophisticated programming, but are simple to use.



2138 public service frequencies. By pushing any one of 11 front-panel buttons, the Service Search will seek out any or all actively assigned frequencies for the service selected. The 300 also features a 50-channel memory bank. Manufacturer's suggested retail price is \$500.

#### Scan for 'mystery' channels

The Realistic Pro-2001 sold by Radio Shack offers the scanner enthusiast a programmable monitor with a 16-channel memory.

An exclusive circuit assures accurate signal tuning, even if the station being received is off frequency. A search capability permits you to scan the entire frequency spectrum to search for new or unpublicized "mystery" channels in your area. The Pro-2001's digital readout constantly displays each frequency as the radio is

*(Please turn to page 196)*



Regency calls its K500 scanner "The Touch," an appropriate name, since programming is done via a keyboard of very sensitive microswitches. With features such as automatic searching, scanners like this quickly find the station you want.

# WORKSHOP MINICOURSE

## BENCH PLANE, PART 3

**T**he adjusting of the lateral lever—which tilts the plane iron right or left—is generally the last step before putting the plane to the workpiece. In most cases, this won't even be needed, but do take the time to check iron alignment before starting. It should look like the blade in photo No. 3.

The piece to be planed should be securely gripped in a vise or tacked to your workbench. If you tack it make certain that the nails aren't in the plane's path or you will nick and dull your iron.

The vise is generally sufficient when planing an edge, but when

to move the tool across the workpiece.

When planing a board's face, move the plane in a diagonal line from corner to corner. Periodically, stop and check the board for flatness with a metal straightedge. Mark any high spots with either chalk or pencil. When you resume planing, remove stock from the spots first.

To finish, plane very lightly—that is, take a very thin shaving—*with the grain*. At this stage, you may have to stop and adjust the blade once more to assure scant stock removal.

Using a plane is not as mysterious



To adjust the plane so that it will produce an even shaving, it's best to move the lateral adjusting lever left or right as you sight along the bottom.



1. Iron with adjusting lever full right.



2. Iron with adjusting lever full left.



3. Iron properly centered with lever.



When you want to plane a long edge, first locate high spots using a straightedge, as in the exaggerated example above.

planing a board's face, it is generally necessary to secure the workpiece firmly between the vise and either a bench stop or a tacked-on workbench clamp.

Make no mistake about it, craftsmen use both hands with a bench plane. The left hand holds the knob at front and guides the plane direction, while the right hand grasps the rear handle and provides the power

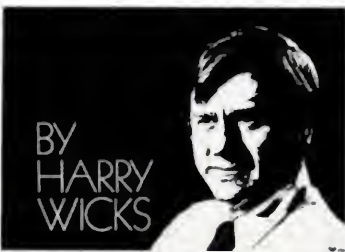


Start planing at the high spot. When piece is relatively straight, you can push the plane the full length of the workpiece.

as some may believe. Remember—if the tool's cutting edge is held square to the work face, the planing job has to be successful. My recommendation to students is to begin practice with clear pine. This wood is relatively inexpensive, yet you can teach yourself the basic skills that you will, in turn, use on more expensive, harder-to-work-with hardwoods.



Finished piece is planed right up to the line to produce the desired straight edge.





Popular Mechanics

FALL '1980

# CAR CARE GUIDE

This special section includes all you need to know to get your car ready for winter—how to choose snow tires, assemble a winter emergency kit, repair rust damage—plus valuable tips. Also: PM looks under the hoods of all the '81 cars.

# Here's the cheapest, easiest, no-gimmick way to save gas.

Just two fingers, two minutes and a few bucks will have your car running cleaner, better, on less gas.

The LEE two-stage Maxi-Air Filter can do that for you. Here's why.

Try running with your hand over your nose and mouth. You'll understand instantly. Because you can't run when you can't breathe. And neither can your car.

To run efficiently, your car's engine needs the right mixture of gas and air. When a dirty air filter chokes the air supply, your engine burns more gas. Expensive gas.

That's why it pays to have an air filter that stays cleaner longer. The LEE two-stage Maxi-Air Filter.

We pack our LEE Maxi-Air Filter

with the extra protection you need against dirt. By using two filters, one backing up the other, our LEE Maxi-Air traps up to 50% more dirt than single-stage filters. And it stays cleaner up to 50% longer. So your engine uses less gas. And performs better.

Last summer, Mt. St. Helens provided the proof. When volcanic ash choked most cars to a stop,



our LEE Maxi-Air kept cars running. Two-stage protection made the difference. It can make a difference for you.

And remember, our LEE Maxi-Oil Filter packs two-stage protection, too. It traps twice the dirt in your oil, lasts far longer than single-stage oil filters to cut engine wear and save you money.

The LEE two-stage Maxi-Air and Maxi-Oil Filters. No gimmicks. Just good clean savings.



**LEE**  
MaxiFilters



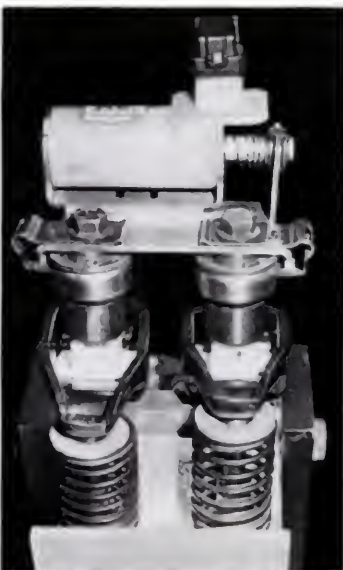
LEE MAXI-AIR FILTER gives you extra mileage, extra protection



**Now For Imported Cars, Too.**



# Saturday Mechanic looks under the hoods of the **GM** models



The major components of Cadillac's variable V8 are the solenoid-activated valve lifters which shut down the cylinders.

**C**heck ignition timing from the driver's seat without a timing light? It's one of the mind-blowing technical innovations you'll find in 1981 Cadillacs. Cadillac also will be offering three engines in one: a V8 for maximum performance, with an automatic electronic cylinder-disengagement system that cuts down to six or four cylinders for better fuel economy.

Although the Cadillac items are the leading attention-getters, General Motors has a long list of significant mechanical and electronic changes. They include digital computer systems with self-diagnosis on every 1981 GM car, and a four-speed overdrive automatic that can lock up like a manual box in any gear in response to computer commands. And although it won't be ready until later in the model year, there's a diesel Chevette with fuel economy to rival the diesel Rabbit.

## Cadillac electronics

Cadillac is determined to be the industry's electronics leader and, at present, it

surely is. The digital computer it introduced last year with throttle-body electronic fuel injection has been reworked to also operate a solenoid system attached to the valves of four cylinders.

When the engine is idling, or accelerating quickly, the computer allows all eight cylinders to operate. For light acceleration and moderate grades, it triggers solenoids so the pushrods merely push up on a sleeve and the valves do not open for Nos. 1 and 4. The pistons move up and down as an air spring, which takes very little power.

For cruising on reasonably level roads, Nos. 6 and 7 also are eliminated, and the 4000-plus-pound car suddenly is powered by a four-cylinder and gets the fuel economy of a compact.

The cylinder-elimination system, designed by Eaton Corp., has been floating around the test labs of all the carmakers for several years, but Caddy is the first to be able to use it, thanks to its high-capacity on-board computer.

In addition, the computer regulates ignition timing, idle speed, a solenoid valve in the vapor-purge hose from the charcoal canister, and solenoid vacuum valves that activate the air-pump system.

The Cadillac computer also has been programmed to do a lot more diagnosis. In the 1980 version, it could diagnose 24 failures and permit the driver to check a variety of accessory switches from the front seat. Failure and switch test results were shown on the digital temperature display for the airconditioning. After a dashboard CHECK ENGINE light went on, the driver pressed the OFF and WARMER buttons on the A/C panel to begin the self-diagnosis.

The display is the same for 1981, but now you can take meter readings of all the sensors and quick-check the solenoids and motors that carry out the computer commands.

Press the OFF and WARMER buttons on the A/C panel to start the procedure, and when you get a code 70, flick the dashboard cruise control switch on and off. Code 90 will come next.

Press the AVG (average mpg) button on the fuel-economy panel and the numeral 1 will be displayed, followed by another





(Please turn to page 128)

## 1980 **FALL** CAR CARE GUIDE





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As push comes to shove,  
the world picks  
**FRONT-WHEEL DRIVE**






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Prepared by the editors of Popular Mechanics with contributors Mort Schultz and Paul Weissler. Technical art by Dale Gustafson, Jeff Mangiet, Fred Wolff, Ed Lipinski, Hank Iken. Design of the Fall Car Care Guide by Don Mannes.

# As push comes to shove, **FRONT-** the world picks

*'It is quite obvious that in 10 years' time every car will have front drive.'*—Alec Issigonis, 1963

by Tony Assenza

AUTOMOTIVE EDITOR

## 1769

### CUGNOT STEAM CAR

Emil Cugnot's steam-powered vehicle was the first recorded automobile ever built. Its single front wheel was powered by a ratchet system which propelled it to a blinding speed of 3 mph. On its only public appearance, it rammed into a wall and was retired.



## 1981

### MERCURY LYNX

Although Ford's Escort/Mercury Lynx is light-years ahead of the Mini in styling and technical sophistication, it still employs the basic principles pioneered by the 21-year-old British Mini.





# WHEEL DRIVE

## 1959

### MORRIS MINI MINOR

Efficient packaging, rugged reliability and excellent fuel economy have made the Mini a legend in its own time. As with all fwd cars, the absence of rear-axle and driveshaft hump means more room for passengers and luggage. The front weight bias over driving wheels provided excellent traction.



850-CC  
ENGINE

FLAT  
FLOORPAN

RUBBER  
SPRINGS

LOW-TURBULENCE  
REAR HATCH DESIGN

INDEPENDENT  
REAR SUSPENSION

LOW-FRICTION  
WHEEL BEARINGS

**W**hile Alec Issigonis might have been a little premature in his estimate of the future, he was by no means any less prophetic. In 1963, when OPEC was merely a loose-knit fraternity of sheiks trying to keep the cost of oil above \$2 a barrel, and the world's car-makers painted rosy pictures of the future, making statements like Issigonis's was risky at best.

Magazines such as PM and the auto publications predicted a future in which the car population was made up mostly of six-passenger sedans traversing the country on high-banked superhighways with speed limits in excess of 150 mph. The American auto industry was geared up to produce nothing but V8s and the Europeans were beginning to fall prey to the lure of cubic inches. The Rootes group was stuffing 289-cu.-in. V8s into their tiny Sunbeam and Donald Healy had shoehorned a three-liter engine into a Jensen.

Against this background of high hopes and escalating displacements, Issigonis seemed



# GM FALL SATURDAY MECHANIC CAR CARE GUIDE

number that is the throttle position in degrees. Run the engine, step on the gas pedal, and you can test the throttle-position sensor and compare readings with specifications.

When you press AVG again, the numeral 2 is displayed, and the sequence of sensor readings continues. No. 8 is ignition timing. About all you don't get is engine rpm, and that can't be too far into the future. Your old test meters could end up accumulating cobwebs.

The test procedure for the solenoids and motors also is simple. Push the AVG button and Code 95 will appear. You now have a choice of two test procedures. The first is performed with the engine off, the second with the car running.

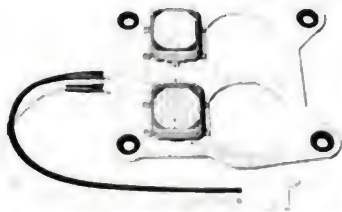
With the engine off, floor and release the gas pedal, and Code 96 will appear. During the next two minutes, the computer will alternately supply juice to two groups of components for five seconds each. All you do is listen and feel the appropriate solenoids for clicks and, in one case (Idle speed), watch a motorized plunger move.

In the first phase, the computer will extend the plunger for the motor that controls Idle speed by pushing on the throttle linkage, plus actuate solenoids that operate the air-pump system and the cruise-control power valve. Next, it will trigger solenoid valves that allow the charcoal canister to purge fumes and the exhaust-gas recirculation valve to turn on. It also will light the dashboard coolant lamp and retract the Idle-speed motor plunger.

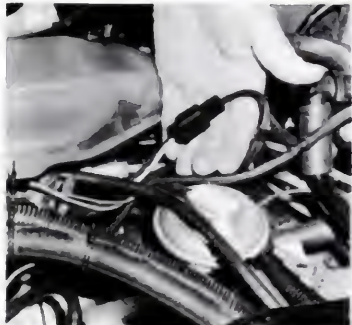
After two minutes, this will stop and No. 95 will appear again. Now you can perform the second test: Run the engine, floor and release the gas pedal and No. 97 will appear. Now you can check the cylinder-disabling system. Press the AVG button and the engine should run on all eight (make this test while cruising down the road). Press the RESET button and you should hear the engine cut back to six cylinders. Press both buttons or the ACTIVE CYL button, and the engine should drop down to four cylinders, even at idle.

Although the airconditioning and mpg indicator panel are standard, cruise control is an option (ordered by 97 percent of Caddy buyers). If you order a car without it, however, there still is a cruise-control switch connector in the harness. Reach under the dash at the steering jacket, pull it down and momentarily apply 12 volts with a jumper from the battery to the cor-

To begin the self-test diagnosis on the '81 Cadillacs, press the OFF and WARMER buttons simultaneously. The system will answer by flashing digital code numbers. The numbers are referred to in the repair manual; they indicate if engine components are working properly. The only function they do not provide is an indication of engine rpm.



The electric heating grid (top) warms the fuel so that the car drives more efficiently from a cold start. The EGR solenoid (right) serves to prevent the car's automatic overdrive from unwarranted surging.



rect terminal, and you'll get the Code 90 test procedure signal.

## Carburetor is gone

All 1981 Cadillacs with a V8 gasoline engine have the throttle-body fuel-injection system (two solenoid-type fuel injectors spraying downward against the throttle plates). This is the first time a complete American car gasoline engine line has been made without a carburetor. In 1980, the throttle-body system was used only on Eldorado and Seville.

The diesel has no spark Ignition system and does not need most of the emission controls of the V8 gasoline engine. Therefore, on-board diagnostics are not included.

## Buick V6 and GM computer

If you want six cylinders all the way, you can order the Buick 4.1-liter V6 on most Cadillacs. It doesn't come with the advanced pushbutton diagnostics of the V8 gasoline engine, but you do get the GM computer that's also being used on all other models.

This one is programmed to identify up to 24 faults (depending on car, model, engine and equipment), but there is no digital display. So the failure codes are indicated differently. Ground a black/white wire hanging from the underdash computer and failure codes are pulsed out by the CHECK ENGINE light. That's it. No ignition timing or readouts from sensors, no switch tests, no quick-check operation of the computer-controlled hardware.

Called Computer Command Control (CCC), it operates different things on different models, although on all it regulates the fuel mixture. This is done by triggering a solenoid in the carburetor, which acts on metering rods to open air on fuel passages. By 1982, many of the cars will have the throttle-body injection system used by Cadillac.

A computer-controlled, all-electric manifold heat valve is new on most 1981 Chevrolets and some other GM cars. Instead of the conventional valve that directs exhaust gases against the base of the intake manifold (to help cold-fuel vaporization for better combustion), there is an electric heater grid under the carburetor base. Current is supplied via a relay on the left fender panel.

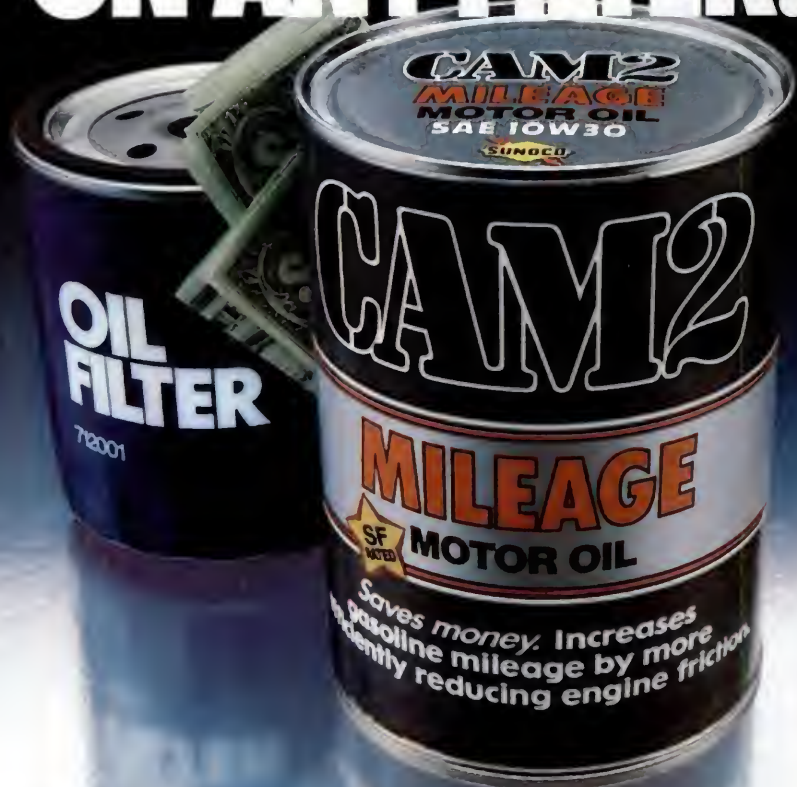
If the car suffers from cold-temperature drive-away stalls and stumble, keep this new system in mind. Probe the electrical connector in the wiring to the grid with a test lamp. If it doesn't light when coolant and ambient temperatures are very low, there is an apparent failure in the circuit that could cause cold stalls and stumble.

The computer also controls a lockup clutch in the torque converter of all automatics with the CCC system. When the computer determines that road speed is high enough (from a speed sensor in the speedometer head) and that the transmission is in the right gear, it triggers a solenoid in the valve body. The solenoid ejects a plunger which closes off an oil

(Please turn to page 130)



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PM

# GM FALL SATURDAY MECHANIC CAR CARE GUIDE

bleed passage. This causes a buildup of oil pressure that results in application of the torque converter clutch.

## Automatic overdrive

With the computer, the lockup clutch could be applied in any gear. However, it is engaged only in third gear on conven-



Auxiliary vacuum pump (arrow) provides added vacuum during wide-open throttle. Most '81 V8s suffer a vacuum shortage.

tional automatics, second and third on a few other cars (such as Camaro Z-28 and Corvette), and third and fourth on a new four-speed overdrive automatic transmission that will be used on V8s and some V6 engines.

The new GM automatic overdrive has more flexibility in operation and slightly greater efficiency than the Ford design introduced last year. However, it is physically larger (has three planetary gearsets instead of the usual two) and weighs more than the Ford design.

The lockup arrangement on all automatics causes some surging at part throttle when manifold vacuum is moderately high (about 5 inches) and road speed is in the 35 to 45-mph range. To smooth out performance, Chevrolet has a solenoid valve spliced into the vacuum line to the exhaust-gas recirculation valve.

When the computer activates the lockup clutch solenoid, it also triggers a solenoid valve, opening a tiny orifice that allows some vacuum to bleed to the atmosphere. This causes the exhaust-gas recirculation valve to close partially, reducing the exhaust-gas flow and thereby smoothing engine performance.

If you get the part-throttle surge, the so-

lenoid is suspect. Disconnect it, try the car again, and if the surge gets no worse, the solenoid apparently isn't functioning. To double-check it with the vehicle running, connect a long jumper wire to the solenoid, run it into the car and connect it to a test lamp. If the test lamp doesn't light at part-throttle medium speed, either the converter clutch isn't locking or the solenoid valve isn't working.

This system is only on Chevy engines (except Citation V6 and four-cylinder engines) at the start of '81 production, but it probably will be incorporated in sister models before the end of the model year.

## Vacuum pump

The use of overdrive, plus smaller engines in many of the cars, results in the frequent use of wide-open-throttle operation, even at moderate speeds, on many late models. As a result, you can be down to just a few inches of manifold vacuum on a slight upgrade.

To cure this vacuum shortage, you'll see a tiny vacuum pump on many '81 GM cars. Although the vacuum is needed for emission controls, it also helps operate the heater-A/C-defroster. So if you hear the flap doors swinging closed and the system going off as a result, when you head up a hill, check the hose connections at this pump.

With the engine running, disconnect the feed hose (not the one from the air cleaner) and feel the end for vacuum. If there is none, the pump is defective.

## GM diesels

Although GM diesels will not be computer-equipped, they have received a fair bit of attention for 1981. The major change is the use of a roller-tappet, which is just what the name implies—a lifter with a roller bearing on the base. The roller is a better bearing than the simple smooth surface of a conventional lifter base, so it can tolerate poorer lubrication.

This permits GM to raise the oil and filter change interval from the nuisance level of every 3000 miles to an acceptable 5000 miles.

You may have heard of the water-in-diesel-fuel problem that has afflicted the injection pumps on the GM diesels, and how a warning-light kit has been released

*GM diesels have a water-in-fuel sensor (right) in fuel tank. Water can be easily siphoned out to prevent metering-pump damage. All diesels also have a fuel warmer (below). It prevents wax buildup in cold weather, a common diesel problem.*



for retrofit. Well, that is factory-installed standard equipment for 1981. In addition, the fuel lines have been redesigned so you can make a disconnect near the tank (no need to drop it) and siphon out the water.

The 1981 diesel V8s will also have an in-line fuel heater, triggered by a thermostatic switch closed by current from the starter key switch below 55° F. The heater warms the fuel, dissolving wax that forms at low temperatures and blocks fuel flow. The wax problem is an old one with diesels, particularly in cold weather. If you have an earlier diesel, you can retrofit the heater.

## Chevette diesel

The GM V8s will be joined by a diesel version of the Chevette, a 1.8-liter, overhead-cam four-banger by Isuzu of Japan. Some time next spring, the Chevette oil burner will make its debut, with fuel-economy numbers of 38 city and 50 highway—or even better with a five-speed manual. An automatic will also be available, and because it will have a lockup clutch in third, there will be little difference in the highway number.

Like the diesel V8, it will have fast-start glow plugs, but controlled through a dual-relay arrangement with a thermostatic switch in the water jacket, temperature-sensing resistors and an electronic control unit.

The glow plugs are very accessible at the top of the engine since you remove for a compression check.

A water-in-fuel indicator is in the fuel filter at this stage, and work is proceeding on an in-tank unit that will be wired in parallel, so that either will trigger a dash-board lamp.

At present it looks as if a 3750-mile oil change and 7500-mile oil-filter change interval will be used.







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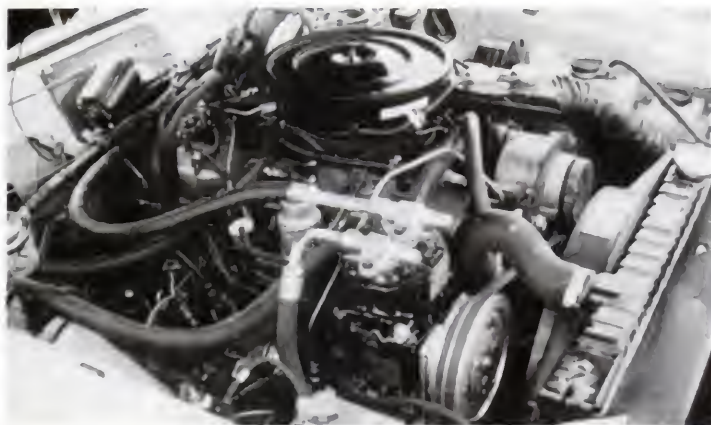
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# Saturday Mechanic looks under the hoods of the AMC models



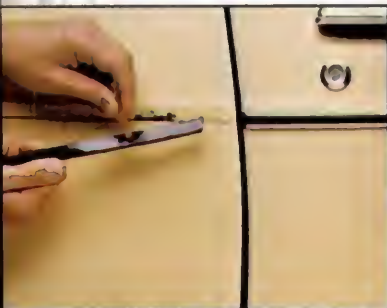
**T**he American Motors six-cylinder engine used to be a simple machine, and it went into an engine compartment that usually was a Saturday mechanic's dream.

Much of the simplicity went out in 1980, when AMC installed a feedback carburetor for a precise fuel-mixture control and the Microprocessor Control Unit (MCU computer) to operate it.

For 1981, the engine has been given a major redesign to shave weight (90 pounds) and a long list of engineering changes for more precise control of emissions, better fuel economy and smoother operation. Now it matches or exceeds al-

AMC's venerable Six receives major improvements for '81. Engine has been lightened by 90 pounds, gets more mpg.

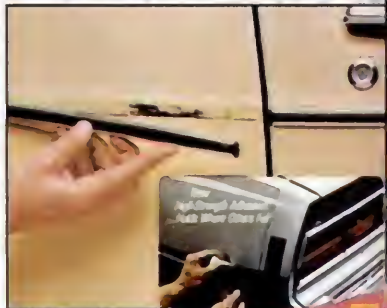
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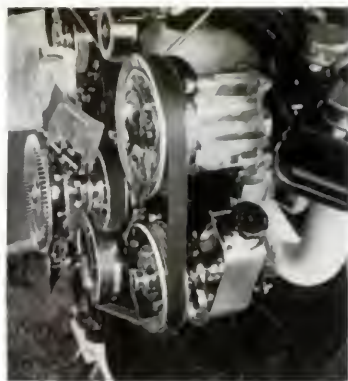
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The single, multigroove drive belt powers all engine accessories for '81 in the California engines only, 49-state cars in '82.

most any other engine for sophistication.

Both water and oil pumps are of aluminum, and the rocker cover is plastic. The engine block is still cast iron; nevertheless it's 30 pounds lighter. The crank dropped 20 pounds and the cylinder head 12 pounds. Among the head modifications was one for enlarging the pushrod bore. Unfortunately, the bore is still not big enough to draw out defective hydraulic lifters. You've still got to pull the head.

The exhaust manifold heat-control valve is gone and, as a result, the manifold itself no longer has a butt joint with the intake manifold for cold fuel vaporization. Instead, there's a 50-amp. electric heater bolted into the bottom of the intake manifold, which is on for initial cold operation, and passages for coolant circulation, which complete the intake manifold warm-up.

If you get engine stumble in cold weather right after starting the car check the wiring connector to make sure that current is flowing to the electric heater. The juice shuts off pretty fast, depending on ambient temperature. So make the check with an ammeter immediately after starting the engine.

### Single drive belt

The single, multigroove drive belt pioneered by Ford three years ago makes its debut on the AMC six-cylinder in California for 1981 (the belt goes across the board on Sixes in 1982). Unlike Ford, however, AMC will not have the spring housing to maintain tension automatically.

"It just wouldn't hold the tension we want (80 to 100 pounds) over the life of the belt," explains AMC power-train engineering chief Dan Hittler.

In fact, AMC installed a twin adjustment setup for the belt, at the alternator, which

is mounted on a two-piece bracket. You loosen three bolts on the brackets, then set tension just as close as you can with a pry bar and the conventional slot-hole adjustment and tighten its bolt. Then you insert a tiny screwdriver into a tiny slot, pry to get the additional tension, and tighten the remaining two bolts.

The new belt is a lot more than a gimmick. Properly tensioned, it is less noisy and draws less power. It also improves city fuel economy by 0.2 mpg, according to Hittler. That may not draw hurrahs, but



To set alternator-belt tension, a small hole in the bracket for a screwdriver is used for making the final adjustment.



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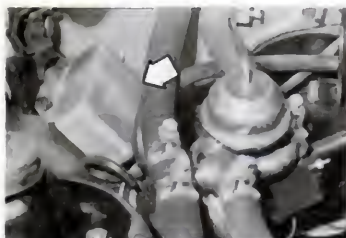
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the big, easy increases all have been made; from now on it's just a fraction of an mpg at a time.

#### Idle speed control

The idle speed is partly controlled by a black box in the right rear of the engine compartment. It isn't exactly a computer, but a tiny chip with just enough instruction to perform three functions:

1. If the airconditioning, intake-manifold heater or rear-window defogger are turned on, or if a low-temperature sensor in the air cleaner closes (under 55° F.), the black box triggers a carburetor solenoid, which ejects a plunger to raise the idle speed about 200 rpm.

2. If the idle speed becomes unstable (two consecutive ignition pulses at a rate of under 435 rpm), the chip activates a solenoid valve that passes engine vacuum to a diaphragm unit in the solenoid. This kicks the throttle linkage up 300 rpm for one second.

3. If the irregular idle condition recurs during the same idle period (such as when you're waiting for a traffic light to change), the extra throttle kick will lock in and hold the higher idle rpm. The black box disengages the solenoid vacuum valve (and therefore the extra kick) when engine speed goes to about 1100 rpm (such as when you pull away from a traffic light).

The whole idea is to lower normal idle speed by 100 rpm for better fuel economy and allow the electronics and the solenoid to jack it up when necessary to prevent overly rough idle or stalling. AMC would like to have put the control into the MCU, but it wasn't possible at this time.

You can check out the solenoid system by turning on the A/C or rear-window defogger, cracking open the throttle and looking to see if the solenoid plunger extends. If it does, that function is good. If it doesn't, probe for current at the wiring

connector with a test lamp. If there's juice, the solenoid is the problem; if there isn't, the fault is either in the wiring or the black box.

You may be able to pinpoint the failure (and also check out the vacuum-diaphragm kicker arrangement) by trying to activate the unstable idle function. Back off the idle speed to lower it to under 435 rpm, and if the diaphragm does not operate the plunger, check for vacuum, first at the end of the hose attached to the kicker, next at the solenoid vacuum valve on the rocker cover (the one on the driver's side; the other two are for the air-pump system and are controlled by MCU).

If there's vacuum going into the solenoid valve, but none coming out when engine speed is under 435 rpm, there's a problem either in the black box or solenoid valve. Probe the solenoid-valve terminals with a test lamp; if there's no juice, then the trouble must be originating in the solenoid.

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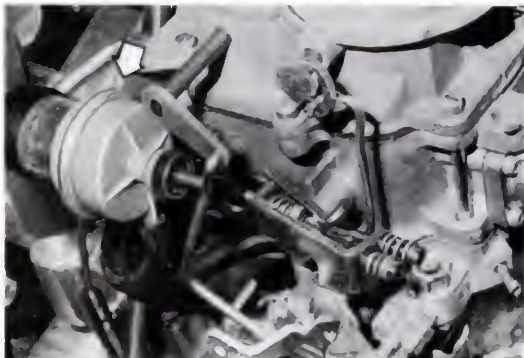
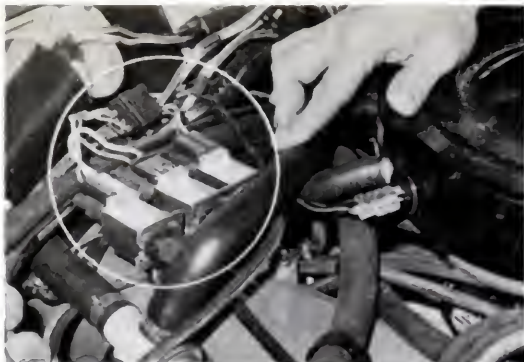
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#### On-board diagnosis

Although the idle-speed control is not too time-consuming for manual checkout, on-board diagnosis is the only way to go. And for 1981, MCU was reprogrammed to include it, by flashing trouble codes on a dashboard light that's located under the fuel gauge.

When the computer senses a failure, the dash light flashes the code five times (it does this only once in a driving cycle, so as not to annoy the driver). The code



comes on only when the failure is occurring. But if two failures exist, only one will be indicated. The second will be displayed only if it occurs a second time during the drive.

The dash light also comes on when the ignition is turned on (before starting the automobile's engine) as a routine check of the bulb.

This is simpler than the Ford system for MCU in which you must hook up test equipment to a special diagnostic connector.

However, only six codes are in the on-board diagnosis for 1981, and each has more than one possible cause. As a result, you'll have to consult the service manual for a breakdown and details on how to isolate the particular problem that's at hand.

One of those items not included is failure of the exhaust-gas oxygen sensor (which signals the computer to make fuel-mixture adjustments at the carburetor). There's no replacement interval for the sensor—you unthread it from the exhaust manifold when it fails and install a new one. As a result, there must be a way to test it.

AMC tried on-board diagnosis, but the computer wasn't able to consistently pinpoint a failure. So there will be a manual procedure with ordinary shop equipment, which AMC was developing at press time. If nothing else, it's nice to know people still can do some thinking the computer cannot—for the present.

PM



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Lowest price of the year

**Sears Heavy Duty 48 Shock**



**Sears Guardsman Bias-Ply**



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\*This is the maximum sale price and minimum savings nationally. Regular price varies in some markets.  
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**We've put in  
more...**



**so you'll put in  
less.**

## **Introducing Kendall® Superb® 100. With a unique formula for saving gas.**

New Kendall Superb® 100 Motor Oil has something extra. Inside every can there's a unique formula that reduces friction so your engine runs easier. And the easier your engine runs, the less gasoline you use.

The next time you change your oil, change to Kendall Superb 100 Motor Oil. You'll be using a great quality oil that helps you use less gas at the pumps. Which all means more money in your pocket.

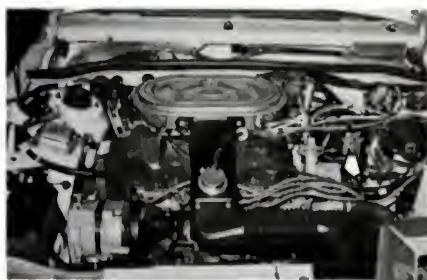


**Protect your investment with Kendall confidence.**

KENDALL REFINING CO., Division of Witco Chemical Corporation, BRADFORD, PA. 16701.



# Saturday Mechanic looks under the hoods of the 1981 FORDS



Distributor (arrow) is mounted directly on the end of the camshaft. Servicing the distributor is easier than it appears.

**H**old a socket wrench a few feet above the engine compartment of a new Ford Escort or Mercury Lynx; then let it drop. If the car had a conventional layout, you'd surely be looking underneath the car for the wrench. With the transverse mounting of the overhead-cam Four, and the drive train packed in too, the odds are you won't find the socket unless you get out the flashlight and start hunting around.

Yes, it's a packed engine compartment, but Ford serviceability engineers are learning how to manage the situation to prevent service disasters.

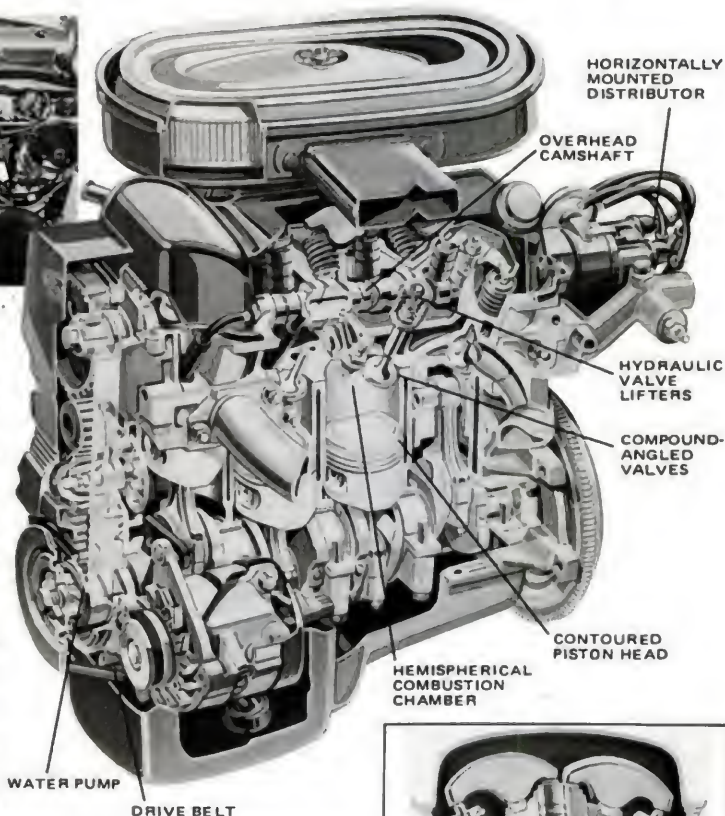
The basic approach, which Ford followed well, was to put the frequently serviced parts in the most convenient locations, and modify the others specifically for their locations.

Sparkplugs are on the front side, and the distributor is bolted to the flywheel end of the engine, at the top. Also, the sparkplug wires are numbered so you can't make an incorrect connection. This is a good idea Ford picked up from its Fiesta.

The wiper motor is in the engine compartment and you can reach it and the linkage easily.

The radiator is very accessible at the front. It's a lightweight design with plastic tanks, but it can still be repaired by a radiator shop. Draining is simple, thanks to a plastic spigot that won't rust-freeze shut.

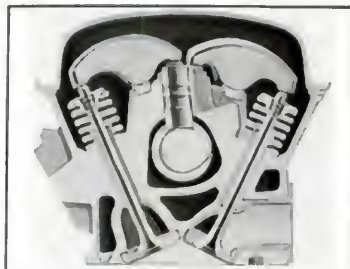
The alternator is at the front top of the engine compartment and has a readily accessible belt adjustment. Ford put a bump-like reinforcement in the alternator housing, just above the outboard bolt,



In designing its new overhead-cam Four, Ford discovered the hemi-head (right) would yield most power, fuel economy.

and that is the place you should insert a screwdriver to apply tension. If you put the screwdriver or a pry bar elsewhere, you could crack the lightweight alternator housing.

If there's one major access problem on the engine, it's the power-steering pump. It's on the rear side, under the air pump, and you must get the adjustment from underneath. Further, you have to loosen three bolts, two of which may be easier from the top. The adjustment is made by inserting a breaker bar or ratchet into a square hole in the pump bracket and shifting the bracket.



One minor serviceability flaw is the water pump, recessed behind and driven off the timing belt. To gain access to the pump, you have to pull the belt guard and the belt. This isn't a terror, but it's nowhere nearly as easy as taking off a V-belt and removing some bolts.

## Carburetor controls

The carburetor is on the rear side of the engine, but the only legal 1981 adjust-



# Ford FALL SATURDAY MECHANIC CAR CARE GUIDE

ment (all others are sealed) is idle speed, and the screw is wide open from the passenger's side of the car. This carburetor has a couple of solenoids, one to prevent dieseling, another to control a fuel-bowl vent for lower fuel-vapor emissions.

The anti-dieseling solenoid is not the fully-external type that retracts to allow the throttle to close fully. Rather, it has a plunger that plugs the idle-fuel passage when the ignition is off. When you turn the key, the plunger retracts to allow fuel flow. If the solenoid fails, or if there's a bad connection, the plunger won't retract, and no fuel will flow through the idle passage.

You can start the engine with a failed solenoid if you crank with the gas pedal floored, but the engine will stall if you try to let it idle.

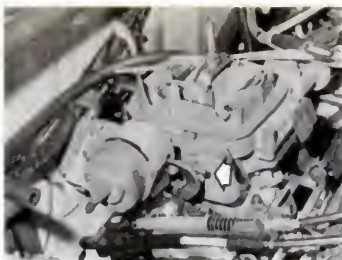
Why would Ford go to something like this? The answer is that a simple idle-screw adjustment in the idle-circuit-passage solenoid is a lot surer and more accurate than one made at the typical solenoid on the throttle linkage, and closing the idle-fuel circuit is a more positive way to stop the engine.

If you suffer a failure-to-start except at full throttle, check the anti-dieseling solenoid. With the ignition on, unplug the wiring from the anti-dieseling solenoid and you should feel or hear movement of the plunger inside. If you don't, unthread and replace the solenoid.

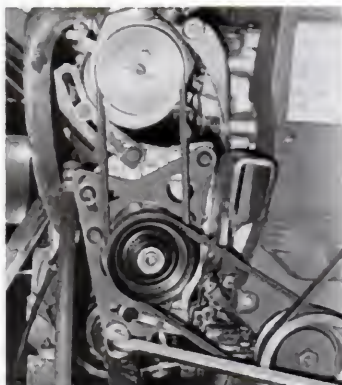
## Bowl-vent solenoid

The bowl-vent solenoid seems harmless but it isn't if it fails. When the engine

**Bowl-vent solenoid reduces vapor emissions while idle-passage solenoid is used to overcome engine run-on (dieseling).**



Idle-speed screw is not sealed in the new Four and is readily accessible from the passenger's side of the engine.



Adjusting the power-steering-pump belt requires loosening three bolts. Two are reached from the top, one from bottom.



Removing the automatic transaxle's governor is a one-minute job. You can reach it easily from the top of the transaxle.



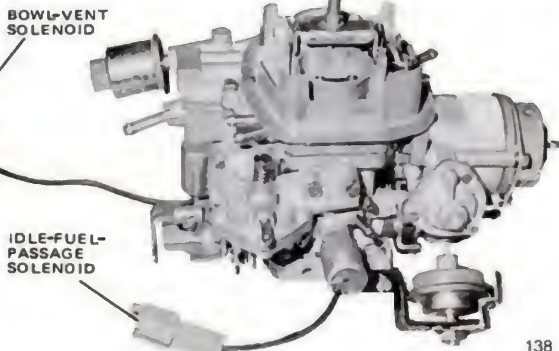
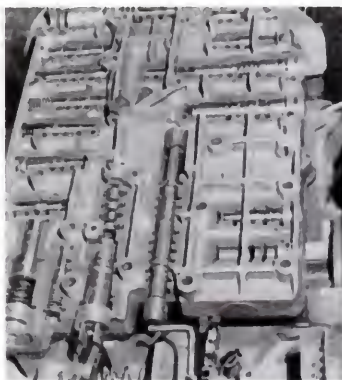
The Escort's radiator tank is made of plastic, and so is the drain cock. It can never rust and "freeze" closed.

is off, the fuel bowl vents to the charcoal canister to hold down vapor emissions to the atmosphere. When the engine starts, the solenoid operates a valve to close off the canister line and open a vent in the carburetor air horn.

Should the bowl-vent solenoid fail in the off position, the air-horn vent will always be closed, and the only venting will be through the canister. The canister,

*(Please turn to page 176)*

Valve body of the automatic transaxle (right) faces upward, is exposed with removal of a metal cover. Computer is tested with voltmeter (bottom right) or Ford-produced STAR (Self-Test Automatic Readout).





# FALL CAR CARE

**Peter Noznesky**, Chairman  
Automotive Parts  
& Accessories Association

**T**he AUTOMOTIVE PARTS & ACCESSORIES ASSOCIATION and Popular Mechanics have been working together since 1972 as co-sponsors of "May is Car Care Month" and now, for the second year are bringing you FALL CAR CARE.

Hundreds of newspapers will be publishing FALL CAR CARE sections this year containing practical and valuable car care information. Manufacturers and retailers will also be contributing helpful hints that can result in more economical car ownership.

Participating manufacturers and the products they are featuring are listed on this page. You will find a list of APAA member retailers on pages 160 and 161. See them for the products that can help you "Drive a Happy Car."

**APAA**  
AUTOMOTIVE  
PARTS & ACCESSORIES  
ASSOCIATION

**Popular  
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**MANUFACTURERS**



Deluxe Hi/Low  
Keyless Alarm  
System  
Hi/Low Electronic  
Current Sensor  
Burglar Alarm System  
EZ Power Converter

**ANCO**

Anco Windshield  
Wipers

**ARMOR ALL**

Armor All Protectant

**bondo**

Complete Body  
Repair Kit

**CHAMPION**

Champion Spark  
Plugs

**CHAMPION LABORATORIES, INC.**

Ace Racer Dual Oil  
Filters  
Ace Racer Dual Air  
Filters

**Chilton's**

Chilton's Auto Repair  
Manual

**creative universal, inc.**

You & Your  
Automobile  
The Talking Car Book



**Custom Trim  
Products**

Body Side Molding  
Door Edge Guard  
Wheel Well Molding

**Dowgard**

Dowgard

**DUPONT**

DuPont Gas  
Booster-Gas Additive

**Motorcraft**

Motorcraft Oil  
Motorcraft Spark  
Plugs  
Motorcraft Oil Filters  
Motorcraft Batteries  
Motorcraft Plug Wires  
Motorcraft Air Filters



Oil Filters  
Air Filters  
Gasoline Filters  
Transmission Filters  
Windshield Wipers  
Autolite Spark Plugs



**SWISS**

Swiss Fibergel  
Repair Kit  
Gojo Extra Heavy  
Duty Creme Type  
Hand Cleaner

**GUMOUT**

Jet-Spray Carburetor  
and Choke Cleaner

**GUNK**



Solder Seal Engine Aid  
Gunk Foamy  
Engine Brits



**HOLLYWOOD  
ACCESSORIES**

314 Data Cruise Trip  
Computer  
313 Time Wiper,  
Automatic Interval  
Wiper Control

**INTERCOMPRESSOR  
INC.**

AP3 SHINE MASTER  
Auto Polisher  
T125 Deluxe Interfilter  
T18 Interfilter



Kit Paste Wax

**Kendall  
MOTOR OIL**

10W-40 Diesel-A-Jug  
& Fun-L-Fill  
Containers

**Kim's**

Blind Spot Mirrors

**LEE  
FILTERS**

Maxi-Oil Filter  
Maxi-Air Filter

**MONROE**

Monroe Shock  
Absorbers

**PEAK**

Peak antifreeze &  
coolant

**PERMA  
GLASS**

Perma Glass,  
Polymer Sealant

**PYROIL**

Pyroil Graphite Oil  
Additive



Quaker State Sterling  
Motor Oil  
Quaker State Deluxe  
Motor Oil  
Quaker State Super  
Blend Motor Oil  
Quaker State HD  
Motor Oil  
Quaker State Oil Filter  
Quaker State Air Filter

**RAC**

Ignition Tune-up  
Analyser Model 500

**SATURDAY  
MECHANIC**

Basic Car Care  
Illustrated

**SCOTSMAN**

Scotsmen Fuel  
Energizer

**SHALER**

Restone Engine  
Treatment



STP Oil Treatment  
STP Gas Treatment  
STP Motor Oil  
STP Son of A Gun!

**turtle wax**

Polyshell System  
Turtle Extra Liquid  
Wax  
Turtle Extra Paste  
Wax  
Zip Wax Car Wash  
Turtle Wax Liquid Wax  
Super Hard Shell  
Paste Wax

**UNION  
CARBIDE**

Prestone II  
Anti-Freeze  
Prestone Superflush  
Simoniz Shines Like  
The Sun Car Wax



1-2-99 Multi Purpose  
Lubricant  
Valvoline All-Climate  
HD Motor Oil  
Gas Line Anti-Freeze  
Carburetor & Choke  
Cleaner  
Heavy Duty Radiator  
Cleaner  
Radiator Sealer &  
Stop Leak

**WD-40**

WD-40

# Saturday Mechanic looks under the hoods of the 1981 CHRYSLERS

*Chrysler's new Imperial is bristling with technical innovations. Main advance is an electronic fuel-injection system to replace the conventional carburetor.*



**"S**peedometer Sam" and all his friends in the shady business of turning back mileage on odometers may be on the way to involuntary retirement. Chrysler's other new car (in addition to the K-car), the \$18,000 Imperial, will pioneer an odometer Sam won't be able to handle. It's an all-electronic device—part of a new solid-state, digital-display dashboard—with permanent memory.

That means you can cut the power (by disconnecting the battery or pulling the odometer from the dashboard) and it doesn't forget. Put it back and it will read the same as before removal.

The basic concept is similar to that of a capacitor (condenser). It is always electrically charged, and the way it is charged varies with increasing mileage. When the power is disconnected, the electrical charge remains in the circuit. Under optimum conditions, it will hold that charge for as long as 10 years, according to Chrysler engineers.

The odometer can be reset to zero, but it takes some pretty sophisticated equipment and engineering talent. So unless Sam can convince his offspring to go to

college and major in electronics engineering and then join him in the "business," the 1981 Imperial may be the beginning of the end.

The remainder of the Imperial dashboard, with its trip counter and other gadgetry, resembles what is being installed in Lincoln Continentals and Cadillac Seville's. Like the Continental design, it has a built-in self-test of the dashboard electronics. It's a pushbutton buried under the dash, just above the steering column, but accessible with the removal of a panel underneath.

Press the button and it goes into self-test, first lighting up all the displays, then checking wiring and mini-computers and flashing the words PASS or FAIL at the appropriate locations on the dash.

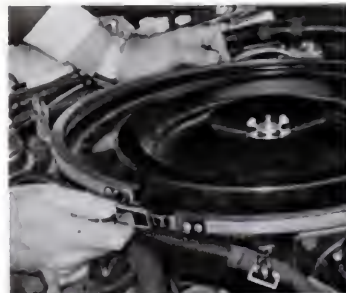
## Continuous fuel injection

The Imperial has a technically innovative under-hood electronic system: a form of throttle-body fuel injection that is a variable but continuous-flow type, compared with the pulsing solenoid-type injectors used by the competition.

PM readers heard all about it back in



*The fuel-injection system is under the air-cleaner cover. Spray bars over the throttle plates inject fuel into the manifold.*



*The air-cleaner cover uses a special sealing clamp to prevent air leaks which might throw off the metering system.*



# What the well-dressed car and driver are wearing this fall.



Buy any two Gabriel shock absorbers\* and get a \$30 vest for only \$9<sup>95</sup>

With Gabriel shocks, a car's well-dressed for either running around the city or roughing it out in the country.

With this Gabriel offer, a driver is too.

Just buy any two shocks: Road Stars, Red Ryders, Striders, HiJackers, Adjustable "E"s or Baja Ryders.

They're all great shocks. Built with the same care as the Gabriel racing shocks on the car that won this year's Indy 500. And now they come with a \$30 vest that's yours for only \$9<sup>95</sup>.

A great vest. A great deal. And reason to stop by an auto parts store or service station where Gabriel shocks are sold.

Dress up the car, and dress up the driver as well.



\*Or strut replacement cartridges.  
Offer good August 1 through October 31, 1990.

**Gabriel**  
SHOCKS & STRUTS

# FALL SATURDAY MECHANIC CAR CARE GUIDE

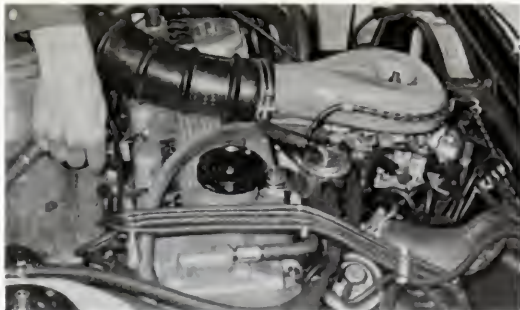
the October '78 issue (see *Servicing the '79 Chrysler-Plymouth and Dodge models*, page 140). Although we hadn't seen most of the hardware, we put together an artist's conception that was almost identical to the final design.

The continuous-flow injection system is used only on the 318-cu.-in. V8. The computer controls spark timing and, via a motor and gearing to a throttle link, controls the engine idle speed, too.

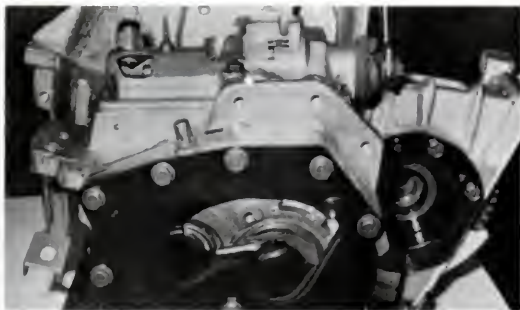
Fuel flows from an in-tank electric pump to a throttle body, where it enters a vane pump. Next, it flows through an accumulator (pressure-control device), then into fuel-spray bars with calibrated holes, just above the throttle plate. The fuel sprays out the holes into the airstream.

The amount of fuel that flows to the bars is determined by the amount of current supplied to an electric motor that drives the vane pump. The greater the amount of current, the greater the pressure and flow. With the engine running, vane-pump pressure ranges from 21 p.s.i. at idle to as high as 60 p.s.i. Above a certain pressure, the fuel forces open a device called a power regulator, and fuel flows through a second spray bar for mixture enrichment.

The vane-pump motor is controlled by an analog computer. The industry is pretty well into digital computers these days (including Chrysler for 1981), but Chrysler did all the development on the fuel injection with analogs and couldn't justify the expense of a switch for such a limited



Although the spark-plugs on the 2.6-liter Japanese-built Four face the firewall on the K-cars, they are still very accessible and easy to replace. Carburetor is on the front of the engine, which makes it very convenient for service.



The manual transaxle can be overhauled without taking it out of the car. By removing the back plate, you are able to have access to the end bearings, both shafts and the gear synchronizers.

production model as the Imperial (20,000-25,000 units annually).

The sensors feeding information to the computer are solid-state air and fuel flow meters. The air-cleaner snorkel is a vane design that causes incoming air to swirl and pulse through a tubing arrangement against a silicon chip, which is normally heated by current from a transistorized circuit. The air pulses cool the chip, and the alternate heating-cooling is converted by the transistorized circuit into an airflow measurement.

The fuel flow is measured by directing a beam of light from a diode across to a phototransistor and placing a paddle wheel in between. As fuel flows through to the spray bars, it spins the paddle wheel, interrupting the light and setting up

a signal which pulses faster as more fuel flows.

The system also includes an oxygen sensor that monitors the exhaust gases and signals the computer to enrich or lean out the fuel mixture as necessary for efficient operation of a three-way catalytic converter.

## Troubleshooting

There are no on-board diagnostics for this computer, but there are reasonably simple quick checks you can make.

If the engine won't start, check for fuel flow. Take off the air-cleaner cover and have a helper turn the ignition key to on. When the key moves to the on position, you should see a single squirt of fuel from the primary spray bars. If you don't see it, go to the Schrader valve in the fuel inlet line and connect a pressure gauge.

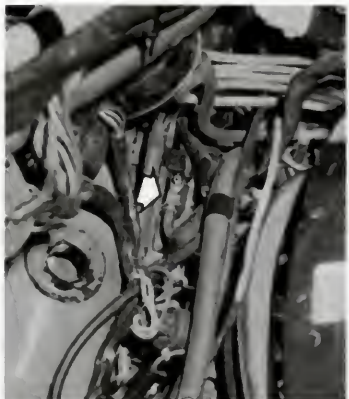
With the ignition key still in the on position, you should get a reading of at least 9 p.s.i. If you don't have a gauge, just place a rag under the Schrader, hit the valve pin with a screwdriver and you should see a strong squirt of fuel.

If you get the fuel pressure at the Schrader valve, the problem is in the throttle body, a job for the dealer. If you don't, perhaps the in-line fuel filter is plugged. Remove it and temporarily substitute a piece of fuel hose in the line. If the fuel pressure comes up to normal, the filter is plugged.

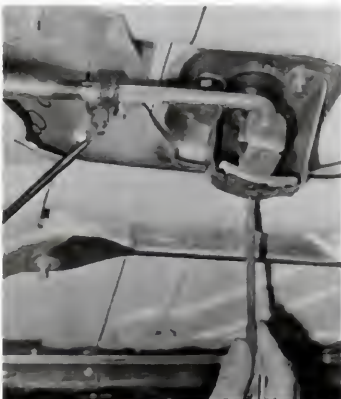
If the filter is good, the problem is likely a defective in-tank pump. Check the electrical connections at the pump. If they're good, the tank must be dropped to replace the pump.

When the car is out of warranty and a

(Please turn to page 172)



Schrader valve (indicated by arrow) is used to test fuel pressure on the Imperial's electronic fuel-injection system.



Manual shift linkage on K-cars is adjusted by lining up two holes, as shown, and tightening the linkage-adjustment bolt.



**Trooper-tested  
Protection.**

**Unbeaten  
Mileage.**



**The two things  
you want from your motor oil  
are both in  
Texaco's Havoline Supreme.**



Indy 500 race car driver Janet Guthrie knows that, today, drivers like you want more than a motor oil that just protects your engine.

You're also looking for a fuel economy tested oil. That's why Janet recommends that you use Havoline Supreme. Texaco's Havoline Supreme is the 10W-40 motor oil with a special friction fighter that's been proven in fuel economy tests. In fact, extensive tests showed that two leading 10W-40 motor oils advertising "extra gasoline mileage" couldn't beat Havoline Supreme.

What's more, in over a million miles of rugged state trooper testing, it delivered proven engine protection, too. Up-front protection backed by unbeaten mileage—two supreme reasons why you should change to Havoline Supreme.



**Trust your car to the products with the Star.**



# Get ready to face the challenge!



Getting stuck in snow can become a life and death situation. Before you go anywhere this winter, make sure you and your car have the necessary equipment to ensure a safe journey.

**D**uring the winter of 1978-79 dozens of snowbound motorists died on a desolate stretch of the New York Thruway near Buffalo. These deaths were especially tragic because they could have been avoided.

The circumstances of this particular tragedy are all too familiar. Unable to reach shelter or find help, motorists who were ill-equipped to handle the unforeseen emergency died of exposure and/or carbon monoxide poisoning.

The root of the problem stems from a careless attitude and the feeling that "It can't happen to me." Once we are inside our cars, protected by several thousand pounds of sheet metal, it's all too easy to feel insulated, totally protected from anything that can do us harm.

Virtually all towns and cities prepare what are called "worst-case" scenarios. They begin with the proposition "What if . . ." It wouldn't be a bad idea, before you begin a winter car trip, to go through a similar drill. What if your car should break down? Have you got enough clothes to

make a trek for help? If you're stranded, can you stay alive long enough for help to get to you? And if someone is looking for you, can you make yourself visible enough for them to find you?

Investing in your survival isn't expensive. And even if it were, it shouldn't stop you. But chances are you've got everything you need right under your roof. You may never need it, but it's the cheapest insurance you'll ever buy.

In the pages that follow, we've covered the most critical areas that you should be aware of. Tires, for instance, are vital for safety, and we'll tell you how to pick the best ones for the job.

In PM's emergency kit we've included the essential equipment for your car.

Body rust that eats away your car is a winter-safety problem because a deteriorated body panel can let in deadly carbon monoxide gas from your exhaust. We show you how to fix it.

Finally, in Sections 1 through 5, we show you how to keep your car in a fine state of tune.

**PM**



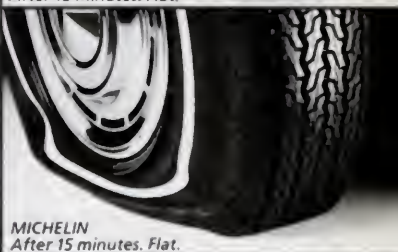


Competitive drilling test  
with 3/16" drill bit  
puncturing Royal Seal.

GOODYEAR  
After 15 minutes. Flat.



GOODRICH  
After 15 minutes. Flat.



MICHELIN  
After 15 minutes. Flat.



UNIROYAL  
No air loss.

Testing was supervised by an independent testing laboratory.

# UNIROYAL FLATTENS THE COMPETITION.

Why would we drill a hole in 4 leading brand-name tires? For one very good reason: to prove that all steel-belted radials are not alike. To prove that Uniroyal's Royal Seal is the one that won't leave you flat.

We drilled a 3/16-inch hole in each tire. The results: Goodyear, Goodrich, and Michelin were flattened. Uniroyal wasn't. That's because inside the Royal Seal is a rubber sealant compound that effectively seals 90% of tire-tread punctures of 3/16" or less in diameter, the size of most tread punctures. Without jeopardizing the tread, the balance or the uniformity of the tire. So you can drive for the full life of the tire.



When the tread is punctured, Uniroyal's special sealant automatically surrounds the puncturing object. As the object is withdrawn, the sealant fills the gap, preventing the air's escape.

This is great news if you don't like stopping on busy highways or lonely back roads. With Royal Seal, chances are you won't get one of the approximately 53 million flat tires that happen in America yearly.

When you're looking for the right tire, remember the test that proved Uniroyal best. When you compare us for quality and compare us for price...you'll buy the tire that won't leave you flat. Royal Seal.

**UNIROYAL**

**WHEN YOU COMPARE, YOU WANT UNIROYAL THERE.**

For a free brochure on the Royal Seal tire, please send your name and address to: Advertising Dept., Uniroyal, Inc., 1230 Ave. of Americas, New York, N.Y. 10020.

The Royal Seal is available at Cadillac, Chevrolet, Buick, Pontiac, Oldsmobile, Ford and Lincoln-Mercury and Uniroyal dealers.

# Choose the best tires for winter driving

If you're looking for snow tires this winter, you're in luck. There has never been such a vast selection to choose from and such a wide array of specialized tires. Like doctors and lawyers, tires these days are becoming more and more specialized. There are tires that will stick to the road like glue in dry weather, but become almost useless when it's wet or snowy. On the other side of the spectrum, there are tires that will make your car act like a half-track in the snow and mud, but will self-destruct if they're driven too long on the highway.

Even if you discount the very specialized tires on each end of the range, you are still left with a large number of tires to choose from.

Aside from the radial and bias-ply con-

structions, the other areas where tires differ are the compound and tread patterns. The compound simply means the type of rubber used in the tire; it can be either soft or hard.

A soft compound tire will give tremendous traction on dry pavement but will not last very long. Because it is soft, it is quickly worn away by friction with the road surface. Hard compounds, on the other hand, wear very well, but don't hold the road as well.

Snow tires are invariably made with a softer compound than general-purpose highway tires because they have to re-

Radial-tire construction offers longer tread life, and gives better traction in snow than bias-belted tires.



main supply at very low temperatures. Their softness, however, makes them wear very quickly if they're driven on pavement for very long. Keep this in mind when you're buying snow tires. Ask yourself how much driving you will be doing in deep snow. If most of your driving is going to be highway mileage, it might not be worth going to the expense of snows. You might be better off with all-season tires.

All-season tires, as the name implies, have been designed to be almost as effective in the snow and ice as they are on dry pavement. These tires are the ultimate compromise between compounds and treads.

Their tread is aggressive enough to get a good bite in the snow and ice, yet aren't so aggressive that they'll be noisy or bumpy when they're driven on dry pavement. Their compounds are also carefully balanced to provide good traction and durability. The major tire makers each have their own line of all-season tires. Goodyear has the Arriva and Tiempos, Firestone Trax 12s, Goodrich All-Season LifeSaver Radials, Uniroyal Tiger Paws, General VSRs, Dunlop Elite 70s and Pirelli P77s.

As good as they are, however, all-season tires are no match for snow tires or mud and snow (M&S) tires in the deep stuff. These tires differ from general-purpose highway tires and all-season tires in their extremely aggressive tread patterns. The only tire that can approach the

(Please turn to page 148)



Self-sealing tires are coated with a rubber-based material which instantly seals a hole after a puncture. These tires will soon eliminate the need for you to carry a spare.



Visually, there is no difference between a tire inflated to 18 p.s.i. and the same tire inflated to 26 p.s.i. The only sure way to check your tire pressure is with a tire gauge.



## Disc Brake Shields

Stop brake dust from  
dirtying up your wheels!



Designed to custom-fit  
your car's wheel type

- Provides extra cooling surfaces to dissipate heat from brakes and wheel bearings
- Installs easily... back away from wheel holes... won't impair important cooling
- It becomes an integral part of your wheel... it won't be noticed, but your clean wheels will be

These shields keep brake material dust off the appearance side of the wheel with absolutely no negative effect on brake performance. Shields pull heat from the brake rotors, diffuse it and dissipate it through the wheel holes. Brakes and wheel bearings run cooler. Helps extend brake life and bearing service interval. Brake parts stay cleaner, improving stoppage under wet conditions and extending life of parts. Made of lightweight aluminum alloy. The wrinkled design adds strength, plus extra cooling surface. To install, simply remove wheel, attach shield, then replace wheel. Custom fit for the following cars—front wheels only:

- 14-1827R—Alfa Romeo All
- 14-1828R—Audi 4000
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- 14-1817P—BMW (5 lug)
- 14-1818Y—Dodge Omni
- 14-1819W—Fiat (except front wheel drive)
- 14-1820U—Ford Fiesta
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- 14-1821B—Lancia (except front wheel drive)
- 14-1823Y—Mercedes-Benz G.E. & Intra Alloy
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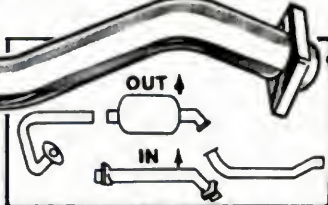
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75-78 Eldorado . . . . .	55-2718R	21.98
76-80 Seville . . . . .	55-2718R	21.98
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77-79 Cougar 351 eng. w/ dual conv., right or left . . . . .	55-2718R	21.98
77-80 Bobcat V-6 eng. . . . .	55-2717A	18.49
OLDSMOBILE Delta 88, Royal, 98, Regency Cutlass, Cutlass Supreme	75-early 77 (32-1/2" long) . . .	55-2718R 21.98
77 late-79 350, 400 eng. (22-1/2" long) . . . . .	55-2717A	18.49
77-79 231, 260, 305 eng. . . . .	55-2717A	18.49
1980 Delta 88, 98, Regency, Cutlass, Cutlass Supreme 307, 350 eng. (w/2-1/2" exhaust extension pipe) . . . . .	55-2718R	21.98
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77-79 231-301 eng. . . . .	55-2717A	18.49
1980 301 eng. w/2-1/4" or 2-1/2" exhaust extension pipe . . . . .	55-2717A	18.49
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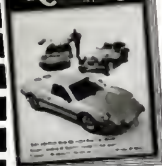
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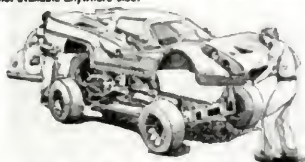
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## FALL SATURDAY MECHANIC CAR CARE GUIDE

### BEST TIRES FOR WINTER DRIVING

(Continued from page 146)

snows in traction is the studded type. Studded tires are banned in Texas, Wisconsin, Florida, Hawaii, Illinois, Louisiana, Minnesota, Mississippi, Pennsylvania and Rhode Island. In all other states they are legal, but subject to restrictions such as road conditions and the time of year.

### Uniform grading system

The government has recently instituted the Uniform Tire Quality Grading System whose goal is to make your selection of tires something better than pure guesswork.

Under this system, all tires on the market are graded for tread life, wet-weather traction and heat dissipation. Durability is graded with a number that's compared to a 100 baseline. A tire rated at 150 will last 50 percent longer than one rated 100. Similarly, a tire rated at 80 will last 20 per-



Difference in tread pattern determines the application. At left is a general-use highway tire; at right an all-season tire.

cent less than one that is rated at 100.

The other two factors, wet traction and heat dissipation, are rated A, B or C, with A being the best score and C the worst. At present most tires will have the grading code printed on a card which is glued to the sidewall.

As soon as the system becomes fully implemented, the code will be stamped directly into the sidewall rubber.

In regard to snow tires, this grading system is particularly significant because all the tests to determine durability are conducted on pavement. When checking snow tires of similar construction, tread design and price, this grading system can make the job of choosing very easy.

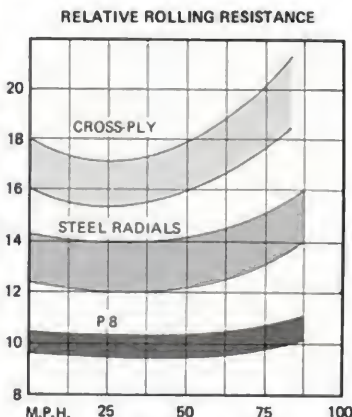
### Chains

Tire technology has come a long way, but nothing is superior to good old tire chains for traction in snow and ice.

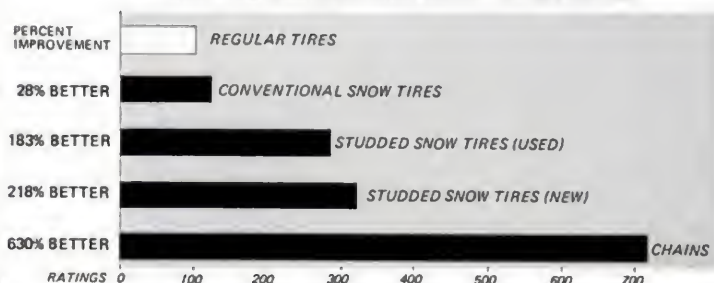
The best type of chains is the kind that completely encircle the tire with a chain web. In tests performed by the Department of Transportation, the determining factor on chain traction was the number of strands on the tire. The more strands on the tire, the better the traction in snow and ice.

The DOT also showed, however, that using chains on clear, dry pavement se-

High rolling resistance can shorten tire life and increase fuel consumption. Radials roll easier than cross-piles. Low-profile tires, like Pirelli's P8, significantly improve mileage. Chart below indicates the superior traction of chains on glare ice.



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verely reduced braking efficiency, put a strain on the suspension and reduced tire life.

## Tire tips

The importance of proper air pressure should be emphasized: Radials don't look much different at 18 p.s.i. than they do at twice that, yet a tire that's only 8 p.s.i. underinflated can wear at twice the normal rate and cut your fuel economy by 5 percent or more. Underinflated tires also build up heat, which can cause a catastrophic failure of the tire and put you in the ditch or worse.

Check and set pressures regularly with an accurate gauge, and remember that tires lose about 1 p.s.i. of pressure for each 10° drop in outside temperature.

In spite of what you may have heard, it's unwise to let air out of your tires for extra traction in snow, ice or mud (it usually doesn't help anyway) because it's too easy to forget to put it back once you're on dry pavement.

Inflating tires to 4 p.s.i. or so over recommended pressure for heavy loads or sustained high-speed running, is a good idea—but do it when they're cold. About 10-p.s.i. overinflation can help traction in snow by bulging out the center of the tread.

The bulging brings out the ridges of the tread, enabling the tire to get a better "bite" in the snow. But it'll also stiffen your ride considerably and cause excessive wear at the tread center if you leave it that way for long.

Finally, "feel out" the road and be careful when things get slick, no matter how good your tires are. You can't expect anything but trouble from tires that are starting to go bald.

If you do get stuck, "rock" the car gently from forward to reverse, but never "gun" your engine because you'll get in deeper, and a free-spinning tire can actually explode from excessive high-speed rotation.

## Remember to mark radials

Mark radial tires "left" and "right" when changing to snows in the fall or back in the spring because radials should not be rotated side-to-side. Store them in a sealed plastic bag to reduce the weathering effects of exposure to ozone in the atmosphere. If they are mounted, they should be half deflated and stored on their sides. If you store a tire on its tread, the rubber will "set" and create a flat spot which will throw off the balance. Before you store a tire, it's also good to protect the rubber with one of the silicone spray products, like Armor-All or STP's Son of a Gun. They penetrate the rubber and keep it from drying out.

Choose the right tires for your vehicle and your local conditions, care for them properly, and you should enjoy trouble-free driving this winter and for many more to come.

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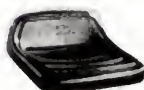
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# Assemble PM's winter emergency driving kit

Whether you're driving across town or across the country, don't leave home without this essential equipment.

**N**ot being able to start a car in cold weather because of a dead battery is one of the most common problems faced by drivers. This is a nuisance when you have to get to work. It can be life-threatening if you're stuck in a desolate area in subzero weather.

You can avoid situations like these with a good set of jumper cables and a booster battery. "Good" jumpers will stand up under heavy use. Some less expensive cables, often made with aluminum conductors, may not.

Read the label on the cable package. The

## Essential tools for safe winter driving

- 1 Tire chains
- 2 Booster cables
- 3 Bag of sand
- 4 Ice scraper/brush and funnel
- 5 Starting fluid, gas dryer and de-icer
- 6 Collapsible shovel
- 7 Emergency flasher
- 8 Spare fuses
- 9 Set of hand tools
- 10 Emergency flares
- 11 Socket set and ratchets
- 12 Empty gas can and tape
- 13 Worklight
- 14 Fire extinguisher
- 15 Tow cable and tire iron
- 16 Antifreeze



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**FALL  
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set you buy must handle the power draw needed from a booster to start your engine.

You don't need a booster if another car around can provide a battery for the boost. If you do buy a separate battery, it could be a used one purchased at a salvage yard. But make sure the booster is kept charged. A dead one is worse than a dead car battery.

If you plan to park in a remote area where



**Military-type folding shovel is indispensable for winter driving. It can be used as a pick or shovel to clear your tires if stuck in snow.**

you won't be able to get a boost from another car, think about carrying the booster in your car trunk. To keep it from tipping, wrap an old belt around the battery as a sling and tie the belt to something secure in the trunk, such as the spare-tire hold-down. Cover the top of the booster with an old blanket to give the battery some warmth.

**Boosting a dead battery**

It's easy to boost a dead battery, but this can be dangerous if it's done the wrong way. The battery can explode, spraying anyone standing nearby with sulfuric acid and shrapnel. This possibility is reduced to virtually zero by following this procedure:

1. **Turn off the ignition** and all electric accessories of both cars.
2. **Remove the vent caps of both batteries** and check fluid level. Refill a battery that's low on water, if possible.
3. **Replace vent caps of the booster battery**, but not those of the battery needing the boost.

4. **Make sure the parking brakes of both cars are set** and automatic transmissions are in PARK (NEUTRAL for manual transmissions).

5. **No parts of the two vehicles should touch.** If they do, a ground connection will be made, keeping power from the battery that needs the boost.

6. **Attach the positive jumper cable to the positive terminal of the booster battery.** Positive cables usually have a red color and are often marked +, P or POS. Attach other end of this cable to the dead battery's positive terminal.

7. **Attach the negative jumper cable to the booster's negative terminal.** Negative cables are black and often marked -, N or NEG. Attach the other end to the downed car's frame, 12 inches away from the dead battery—for example, on the alternator bracket. This connection is safer than one to the dead battery's negative terminal. It reduces the possibility of hydrogen gas, produced and emitted by the dead battery as it receives the boost, from being ignited by a spark.

8. **Turn on ignition of the car with the dead battery** and start the engine.

9. **Disconnect jumper cables in the following order**, when the engine starts: (a) negative cable from the car frame; (b) negative cable from the booster battery; (c) positive cable from the booster; (d) positive cable from battery that received the boost.

Boosting a maintenance-free battery is done the same way, with these precautions:

1. **If the battery has a visual indicator** that's pale or yellow, don't boost the battery. If it's dark with no green dot showing, the battery needs a boost.
2. **If the battery has no indicator** and no way to open battery cells to check electrolyte level, don't jump-start the car if it can be avoided. A battery explosion may result. Instead, if the booster has the same terminals as the car battery so cables can be connected, remove the maintenance-free battery and replace it with the booster. However, if you're stranded on a freezing night with a dead battery and a booster that can't be used as a replacement, take a chance. Jump-start the engine, but beware of a possible explosion—don't hover over the dead battery.

**Live battery, dead engine**

Sometimes in cold weather the battery is willing but the engine isn't, and there's no help in sight. Maybe the fuel has run out. All you can do is start hiking and hope to find an open service station. If so, you can use the gas can and funnel in the emergency toolkit. You may wonder why we don't suggest carrying a couple of gallons of gas for such an emergency. A can of gas in the trunk is an invitation to disaster.

If fuel is not the problem, having the right equipment in the toolkit can be a lifesaver. Consider the following:

- Suppose wind-driven snow under the hood has fallen on ignition parts and water has caused an interruption of electricity, making the engine stall. The simple act of wiping parts off with a dry rag from your toolkit may help the engine restart.
  - Maybe the choke plate isn't operating. If it's stuck open, the fuel mixture won't be rich enough to start a cold engine. If it's stuck in the closed position, the engine will start, but will then flood and stall.
- Remove the carburetor air cleaner. If the choke plate is open when it should be closed, close it by hand. If it won't stay closed, wedge it



closed by placing a screwdriver between the carburetor air-cleaner hold-down and the carburetor or by laying a heavy tool, such as a wrench, on the choke plate. When the engine starts and runs efficiently, remove the tool and let the choke plate open.

If the plate sticks closed when it should be open, release the choke arm from the fast-idle cam to open the plate. Keep it open as you drive to safety by wedging it with a piece of wood or screwdriver handle.

■ Maybe the fuel system has plugged up, and fuel can't get to the carburetor. To find out, operate the throttle lever while looking down the carburetor throat. If there's no strong squirt of fuel, the filter is clogged, the fuel pump has failed, ice is in the fuel line or there's trouble in the fuel tank.

On a chance that ice is causing the blockage, pour some hot water over the fuel pump, fuel line, fuel filter and carburetor inlet. Where will you get hot water in the middle of nowhere in winter? If the engine is still hot, drain some coolant from the radiator. Hopefully, you'll have a receptacle, such as an empty gas can. If not, catch the coolant in a hub cap. You can drop coolant level about a quart and still drive safely, assuming the coolant is at normal level. If the engine is cold so coolant is cold, but there's snow on the ground, scoop snow into a receptacle, start a fire and heat the receptacle.

There may be an easier solution. Suppose the blockage is concentrated at the fuel filter. You can take the filter out of the car. If the filter is causing the trouble, the engine will start and run without it. Of course, if you carry a spare filter, use it.

If the car has an internal fuel filter, use wrenches to remove the fuel line at the carburetor inlet. Remove filter and spring. Then, reconnect the line and start the engine.

If the car has an in-line fuel filter, take it off, but retain the clamps, if you have no spares. Connect the two parts of the fuel line; perhaps you're carrying some vacuum hose which will do the job. If not, find a hose of suitable diameter in the engine compartment. Perhaps a piece of windshield washer hose or PCV hose will do.

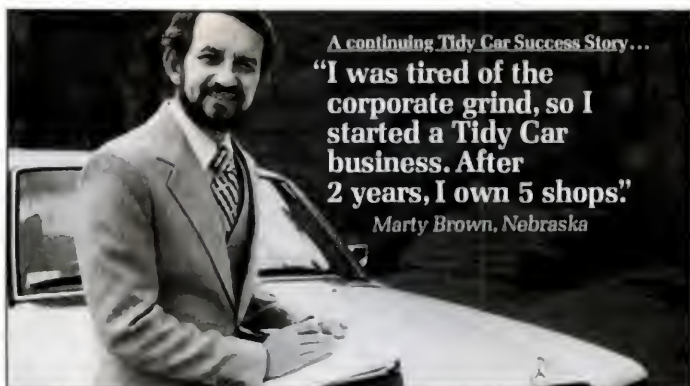
If the engine has destroyed a vital part without which it won't run, such as a drive belt or fuel pump, you can't start it unless you have a spare in your kit. In deciding which parts to carry, ask yourself, "Which parts are most likely to fail?" (You can cut expense for spare parts by setting up a periodic inspection program to insure that such parts as drive belts, distributor points and ignition cables aren't about to fail.)

Sometimes you can fix a part for which you have no spare just enough to limp to safety. Suppose a cooling-system hose suddenly spouts a leak. If you're carrying electric or duct tape, wrap it around the break.

## Stuck car

Drivers often find their cars won't move because they can't get traction on ice or in deep snow. According to Firestone Tire & Rubber Co., tire chains are the best traction aid for driving in snow or on glare ice. A set in the trunk can be a lifesaver in severe weather. Chains are mounted on the tires of driving wheels; that is, the rear wheels of cars having a rear differential and the front wheels of cars having a transaxle.

If you don't have tire chains, a shovel and a bag of sand or rock salt may help. Dig deep snow away from the front of tires and spread sand or rock salt. You will probably gain sufficient traction to break the car free.



A continuing Tidy Car Success Story...

**"I was tired of the corporate grind, so I started a Tidy Car business. After 2 years, I own 5 shops."**

Marty Brown, Nebraska

Marty Brown's Tidy Car business has been a success almost from the very beginning. After only nine months in the business he started a second shop location. In two years he now has five Tidy Car locations, giving superior car appearance maintenance services to car owners throughout the Midwest.

Looking back a short two years, Marty still remembers working 65 hours a week in charge of cost accounting for a large company.

"I simply wasn't being compensated enough for the tremendous pressures of balancing budgets and preparing forecasts for 107 company branches," he explained. "Plus, when I considered the real hours I was working and the expense of my college education, it just wasn't worth it."

"I looked into starting my own accounting office, leasing vehicles, even owning a golf course. Then I read about Tidy Car."

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"I don't shine cars myself anymore. In fact, after the first six months, I had eight operators working for me while I managed the business."

"What you know about cars initially doesn't matter so much as your ability

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# How to repair rust damage on body panels

**A**ny rust damage on your car's body should be repaired before road salt gets a deeper bite. If rust isn't taken care of promptly, what is a small hole in the fall could become a very large one by the end of winter.

The tools you'll need to do the job are few and inexpensive. First off, you'll need a grinder attachment for your drill to grind away surrounding paint and rusted metal. You'll also need body filler, a cheese-grater file, primer paint, glazing putty, a sanding block and various-grit, wet-or-dry sandpaper.

When using sandpaper, keep in mind that the lower the number of the grit, the coarser the paper will be. The coarser paper is used for rough work, such as sanding down dry putty, while the finer grits are used for feather-edging and finishing work.

When you inspect for rust damage, make sure to check both sides of the body panel. Very often, surface rust is only an indication of deeper trouble. That's why you should grind not only the rust spot, but the immediate area around it. Also, make sure to grind down to bare metal. Any residual paint, primer or rust will prevent the patch from taking a good hold on the surface of the panel.

Of particular importance in winter is to check for rust holes, which may allow carbon monoxide to enter the car. Look under the car for visible holes in the floor pan. Also check that the drain holes are clear. If they aren't, clean them with a piece of wire. If you suspect rust, but can't see it, tap the metal with a hammer or wrench. If you hear a dull thud rather than a metallic ring, it's an indication that rust has already formed on the inside of the metal.

If you want to find out more about auto body repair, see *The PM Garage*, page 80.



Rust that appears superficial at first glance may turn out to be more serious. After grinding, what appeared to be a small spot turned out to be a hole. Be sure that you grind out as much rust as possible.



Tap down any sharp pieces of ragged metal with a hammer and punch. Then tear off a small wad of plain steel wool and insert it snugly in the hole. Tuck in any strands of wool that may hang loose.



Mix plastic body filler and hardener thoroughly. Then, working quickly before the hardener sets up, spread it carefully over the hole. Press down firmly to work out any of the air bubbles that may appear.



Using the rounded side of a cheese-grater file, remove any high spots. Do this while the surface of the filler is still fairly soft. You must keep the file flat against the filler to avoid gouging deep furrows.



Sand the filler with No. 40 grit paper in a sanding block. Replace the No. 40 grit with No. 80 grit after the grooves have been smoothed down. Feather-edge with No. 80 and finish the surface with No. 120 grit.



Before spraying primer, mask the surrounding area with paper. Use short, light strokes, covering the filler a little at a time. If you should use too much primer at once it will build up and run.



Smooth on the glazing putty. Press fairly hard with a squeegee and make only one pass in each direction. Each stroke should overlap the previous stroke. Let the putty dry completely before wet-sanding.

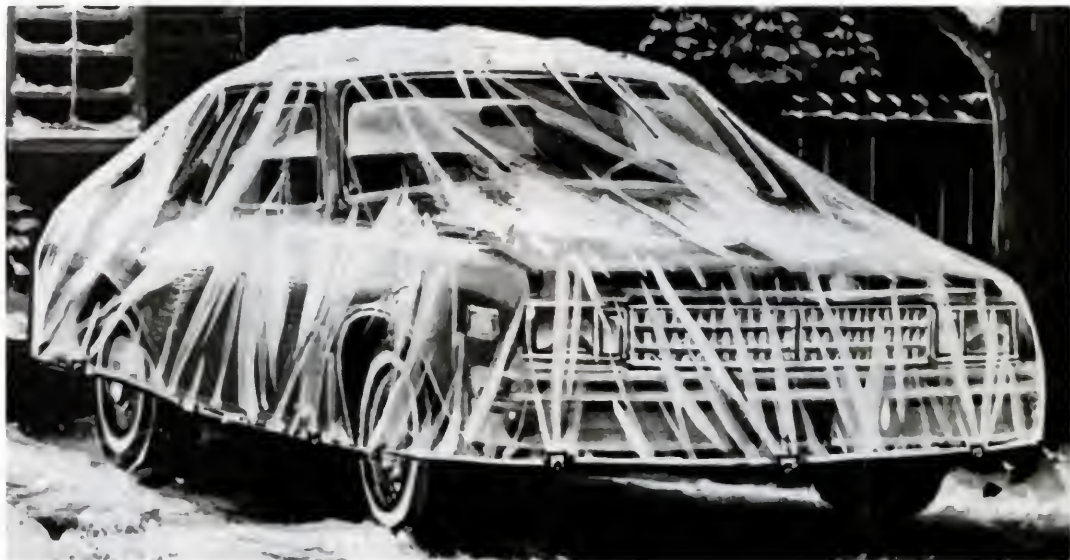


Using No. 320 grit paper in a sanding block, wet-sand the whole area until all edges are smooth. Hold the sponge above the block to keep the area wet. Dry completely, prime and you're ready for painting.



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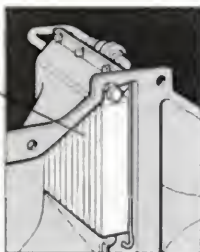
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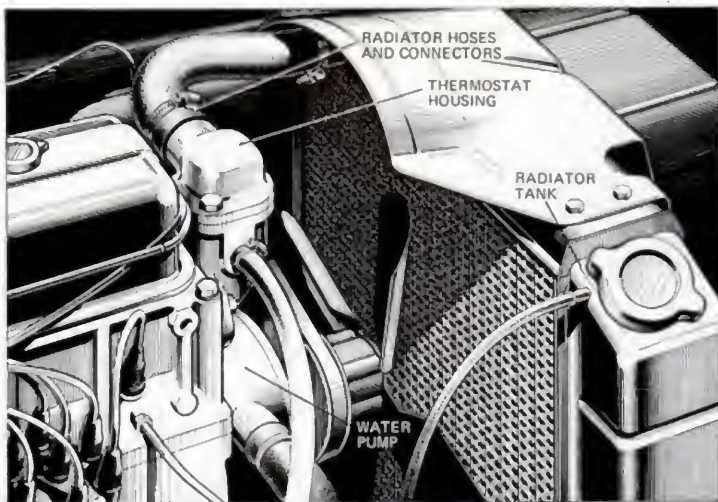
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

# FALL SECTION 1 CAR CARE GUIDE

HEATER CORE



The most common areas where leaks occur are at radiator hoses, water pump, thermostat housing and heater core (above).



## Servicing the cooling system

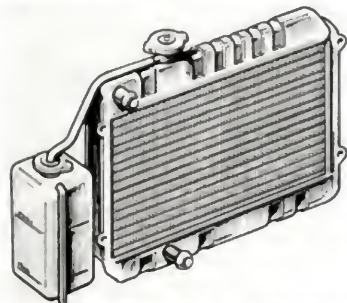
**C**ooling system winterization involves:

- Checking hoses.
- Testing the radiator pressure cap.
- Examining the cooling system for leaks.
- Testing the thermostat.
- Draining and flushing the system.
- Adding fresh ethylene glycol antifreeze.
- Inspecting and adjusting drive belts.

### Checking and replacing hoses

There are two radiator hoses—one at the top of the radiator and one at the bottom. There are two heater hoses—one that transmits coolant from the engine to the heater and one that returns coolant from the heater to the engine. Some cars have a water-pump bypass hose. Other models, such as Pinto, Mustang II, Bobcat and Vega, have hoses that go to and from the automatic choke housing.

All hoses should be checked, since any one of them may split and cause a sudden loss of coolant. An inspection will uncover a hose that's in poor condition.



Coolant recovery units should be checked along with radiator. Check for a blockage in the recovery and overflow tubes.

With the engine cold, squeeze each hose over its full length. Replace hoses that feel hard, brittle or mushy, as well as those that are cracked.

Check for cuts by loosening the clamps and sliding them back to expose the covered areas of the hose. Replace a cut hose.

Start the engine and wait until the cooling system is hot. Examine hoses for swelling. Swelling indicates an internal weak area that can burst under pressure. Replace such a hose.

The procedure for replacing faulty hoses is as follows:

1. **With the engine cold, drain the radiator.** If coolant is clean and is going to be reused, catch it in a clean pan.
2. **Loosen clamps and remove the hose from connectors.** Do not force a stubborn hose off a connector. You may twist and damage the connector. Instead, cut the hose off. Discard the clamps.
3. **Using a wire brush or sandpaper, clean the connectors.** Then, coat them with waterproof sealer. Your auto parts and accessories dealer can suggest a product.
4. **Slide new clamps on the hose.** Worm-drive clamps are the easiest to use. In time, however, they may loosen because of vibration, so every few thousand miles you should retighten them.
5. **Push the hose onto the connectors.** If the hose is stiff and difficult to manipulate, soak its ends in hot water for a couple of minutes to make the hose pliable.
6. **Position the clamps  $\frac{1}{2}$  to  $\frac{3}{4}$  in. from the ends of the hose.** If clamps are set at the ends of the hose, pressure might build up behind the clamps, causing the hose to burst. Tighten clamps securely.
7. **When the engine is warmed up and running, check around clamps for coolant leaks.** If necessary, tighten clamps more.



Inspect hoses for fatigue by squeezing them with your hand. They should be firm and free of cracks when squeezed.

### Testing the radiator cap

Use a cooling system pressure tester to test the radiator pressure cap. If the cap does not work properly, correct pressure will not be maintained. The boiling point of the coolant will rise. Overheating may occur, and coolant may be lost.

To test the radiator pressure cap, proceed as follows:

1. **Remove the cap from the radiator.** Make sure the engine is cold to avoid injury from a spray of hot coolant.
2. **Note the pressure rating stamped on the cap.** If you replace the cap, get one with the same pressure rating.
3. **Wash the cap in cool water and dry it with a clean cloth.**
4. **Attach the cap adapter** to the radiator pressure tester and connect the cap to the adapter. Hold the tester so the gauge dial faces you and activate the tester pump until the dial needle records the rated pressure of the cap. If the needle fails to reach this level, remove the cap from the adapter, reattach it and try again. Do this a few times before discarding the cap as faulty.
5. **After the pressure rating is recorded on the pressure gauge, watch the needle.**

(Please turn to page 158)





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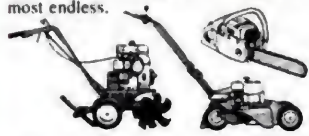
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# FALL SECTION 1 CAR CARE GUIDE

## THE COOLING SYSTEM

(Continued from page 156)

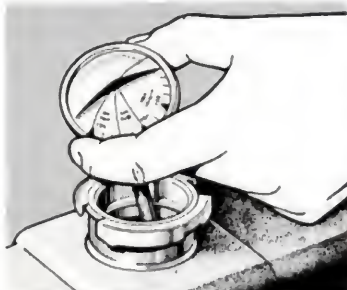
The needle should remain steady at or within 2 p.s.i. of the pressure rating for at least 30 seconds. If it doesn't, replace the cap.

### Testing cooling system leaks

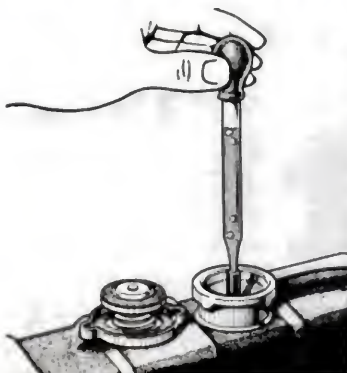
Check the cooling system for leaks by attaching the pressure tester to the radiator filler neck (the engine must be cold).

If the radiator has an overflow tube running down its side, disconnect the tube from the filler neck and run a wire through the tube to test for an obstruction. The tube has to be clear to permit escape of excess pressure created during the test. If pressure can't escape, the radiator or some other part of the cooling system may be damaged. Similarly, if the radiator is equipped with a coolant recovery system, see that the hose from the radiator to the recovery tank and the overflow tube aren't obstructed.

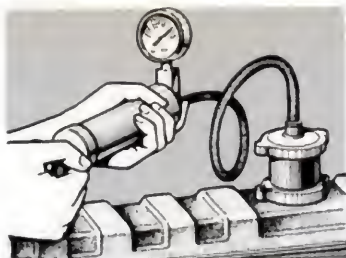
Pump up pressure until the gauge dial



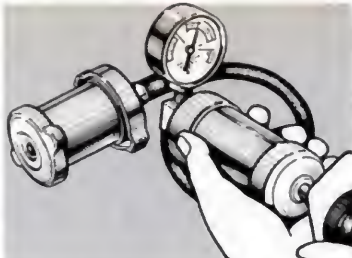
A quick check of thermostat operation can be done with a thermometer. Check to see at what temperature water begins to flow.



An inexpensive pellet-type hydrometer is all that you need to test for the antifreeze property of the engine coolant.



To test for leaks in the cooling system, pressurize it with a cooling system analyzer. Coolant will squirt from leaks.



Cooling system analyzer is also used to test the radiator cap. If the cap doesn't hold pressure, it's time to replace it.

records the pressure stamped on the radiator cap. Do not exceed this pressure, since damage to the cooling system can result.

One of the following conditions will occur:

■ The gauge dial will not move for at least 20 minutes. This means the cooling system is free of leaks.

■ The gauge dial will fall away slowly. This means there is a small leak. Examine the radiator, radiator drain cock, all hoses, water pump housing, thermostat housing, heater core and engine core plugs. Find and fix the leak. Small external leaks can often be sealed by adding a stop-leak solution to coolant or by adding ethylene glycol antifreeze that contains an anti-leak additive.

■ The gauge dial will fall away quickly. This means there is a major leak in one of the areas just noted.

If you cannot find the source of a leak, the leak may be inside the engine. Remove the pressure tester, attach the radiator cap and run the engine. Draw out the oil dipstick and look for globules in the oil to verify the existence of an internal leak. Also inspect the automatic transmission fluid dipstick for globules that signify the transmission oil cooler has sprung a leak.

### Checking a clogged radiator

Warm up the engine. With the engine off, run your hand over every inch of the radiator core, from the inlet end to the outlet end. If one spot feels colder than the general area, it means the radiator is clogged at that particular point.

Try to clear a clogging problem by first clean-

ing dead bugs and other debris from radiator fins. Aim a water hose through the fins from the engine side. If you use a brush to loosen bugs, work carefully so you don't bend the fins.

Now, drain and flush the cooling system. If this procedure isn't successful, the clogged radiator should be treated by a professional cooling system facility.

### Draining and flushing

To keep a cooling system in good operating condition, drain and flush the system once every two years if the car has less than 50,000 miles. If the car has more mileage than this, drain and flush the cooling system once a year to prevent a buildup of sludge.

As long as there is no buildup of sludge—revealed by murkiness of the coolant as it is being drained—draining and flushing are simple processes. Open the drain cock at the bottom of the radiator to let coolant drain. If there is no drain cock, remove the lower radiator hose to drain coolant.

To flush the system, close the drain cock, fill the radiator with water, replace the radiator cap and let the engine run at idle for several minutes. Shut off the engine and drain the system again.

Don't forget to remove the radiator cap when draining the system, but be careful—pressure may have built up as the engine was running. Open the drain cock and let water run out. Repeat this flushing procedure until the water that drains out looks clean.

If sludge persists, the system may need more forceful flushing. This may be done with a radiator flushing kit available at auto parts and accessories dealers. Instructions contained in the kit describe how to use it.

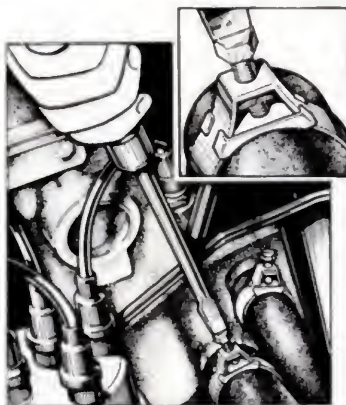
### Install ethylene glycol

The U.S. government General Services Administration (GSA) says, "You really have little choice in selecting an antifreeze/coolant if you want year-round protection for a modern car. You buy ethylene glycol with rusting and corrosion inhibitors and with or without anti-leak additives."

The right concentration of ethylene glycol for every area of the United States, except the most northerly regions, is a mixture of 50 percent ethylene glycol antifreeze with 50 percent water. This mixture provides protection from freezing in temperatures as low as 34° F. below zero.

"If a half-and-half solution of ethylene glycol and water does not provide protection against freezing to -34° F., the product is below standard," says the GSA.

Use a hydrometer to check antifreeze concentration periodically during the cold weather (Please turn to page 174)



Old-style tower clamps should be checked more frequently than the new worm clamps. Position them 1/4 inch from end of hose.



# Servicing the engine

Statistics show that engines allow little room for poor maintenance in cold weather. According to the Automobile Assn. of America, approximately one-third of all car owners in the United States have engine-starting problems during the winter.

Run-down batteries often get blamed for most of the trouble. However, "in most situations the battery is simply run down in futile attempts to start the engine," Champion Spark Plug Co. contends. Champion bases this conclusion on a survey which revealed that batteries recharged after being discharged during starting attempts experienced a high rate of repeated failure.

"In winter starting, the condition of the ignition system is equally important to the condition of the battery," Champion says.

## Servicing the ignition system

- Replace sparkplugs that have worn electrodes, broken insulators or damaged shells. Clean and regap sparkplugs that aren't worn or damaged and can be kept in service.

- Replace sparkplug cables if insulation is cracked, split, or brittle. Disconnect cables at the distributor cap, sparkplugs and ignition coil. Examine terminals. Replace cables if the terminals are burned or corroded.

One reason terminals burn is that they aren't firmly seated. Make sure connections are tight. Loose cables reduce ignition efficiency and cause hard starting as surely as defective ignition components do.

- Inspect the distributor cap, rotor and ignition coil. Look for cracks or carbon tracks that signify cracks. Examine terminals and contacts for burning and corrosion. Replace damaged components.

- If your car is equipped with conventional (non-electronic) ignition, examine the distributor points. Keep points in service if they have a silver-gray finish, but pass a fine-cut ignition file between them, one time only, to remove any coating. Then, set point gap and dwell.

Replace points that are badly pitted, oxidized or coated with oil. An oily coating suggests that a clogged PCV system is pushing oil vapors into the distributor. Test the PCV system and replace if a new PCV valve is needed. **Note:** Replace the condenser when you replace the points.

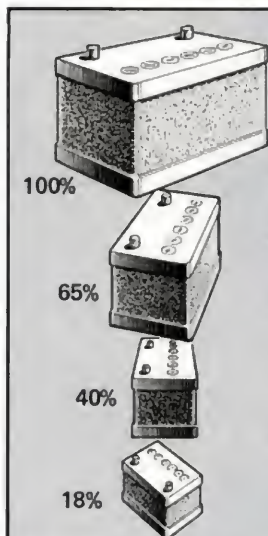
- Check that the condenser and primary wires are sound. A bare wire can ground itself against the side of the distributor, causing a short circuit that will bring the engine to a dead stop. A pinched wire can have a break that will prevent current flow, keeping the engine from starting. Make sure wires are secured tightly.

- After setting carburetor slow-(curb-)idling speed, adjust ignition timing to the specification given on the vehicle emission-control label mounted in the engine compartment.

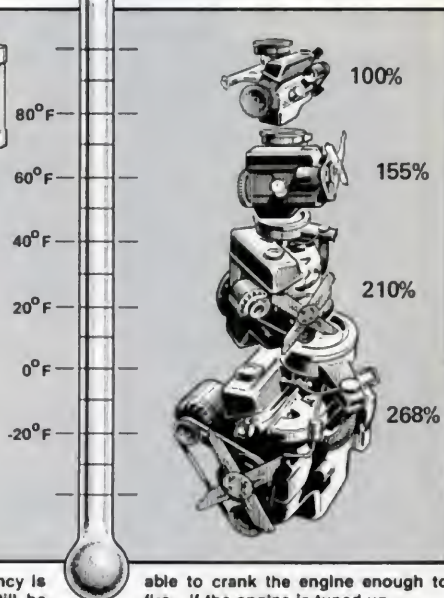
## Winterizing the fuel system

A fuel system must neither restrict the flow of fuel to the cylinders nor cause an excessive

STARTING POWER AVAILABLE FROM BATTERY



STARTING POWER REQUIRED BY ENGINE



Even though a battery's efficiency is reduced in winter, it should still be

able to crank the engine enough to fire—if the engine is tuned up.

amount of fuel to enter the cylinders. If an engine starves for fuel or is overfed with fuel, starting and/or running problems will occur.

- Service the carburetor air filter. If the air filter is dirty, replace it.

A dirty filter restricts the flow of air to the cylinders. The fuel mixture will be very rich and it could lead to starting trouble.

- Service the fuel filter. Don't take a chance this winter with a fuel filter that has more than 15,000 miles on it. A partially clogged filter restricts the flow of fuel, which makes starting difficult and stalling more likely. A completely clogged filter prevents starting altogether.

One way to help keep fuel filters from clogging in winter is to use gasoline antifreeze, es-

pecially if you don't keep the fuel tank completely filled.

- Test the automatic-choke system. With the engine cold, remove the air cleaner to uncover the choke plate. Have someone start the car as you watch the plate.

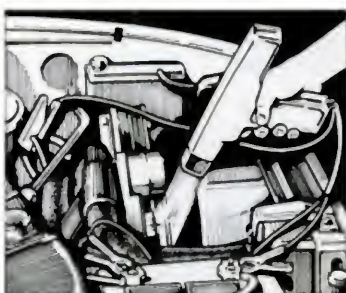
Before the engine turns over, the choke plate should close over the carburetor throat. As soon as the engine starts, the choke plate should open partially. It should then proceed to open wider and wider until it is fully open.

If this does not happen, turn off the engine and clean the choke plate and linkage with carburetor cleaner.

- Set idling speeds. Hook up a tachometer (Please turn to page 163)



Check sparkplug terminals for corrosion at both ends. If they are badly pitted or are rusted through, replace them.



To ensure reliable performance, set the engine's ignition timing. Do this after servicing any parts that are defective.

# FALL CAR CARE

## RETAIL MEMBERS

These retailers and their more than 10,000 stores and automotive departments carry many of the products you will find listed on page 000. They are members of the Automotive Parts & Accessories Association and join the APAA and Popular Mechanics in promoting FALL CAR CARE.

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<b>ACE</b> AUTOMOTIVE	AK, AL, AR, AZ, CA, CO, CT, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MS, MT, NC, NE, NJ, NM, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, WA, WI, WV, WY
<b>ACTION AUTOMOTIVE</b>	MI
<b>Advance Auto</b>	NC, SC, TN, VA
<b>Aid</b>	NJ, NY, CT, FL
<b>AMERICAN BATTERY CO.</b>	NJ
<b>Auto's</b> AMERICAN FOREIGN DISCOUNT Auto Parts & Supply Stores	CA
<b>ARROW</b> AUTO PARTS SUPPLY	MO
<b>ATWOODS</b>	OK

<b>AUTO BARN STORES</b>	NJ, NY
<b>Avellino's</b> Tire & Auto Service Centers	PA, NJ
<b>BALE TIRE CENTERS</b>	KY
<b>BIG WHEEL</b> Auto Centers	MIN, WI
<b>BLUE STAR</b> Auto Stores	IL, IN
<b>BOWDEN'S AUTO PARTS INC.</b>	WA
<b>BUCHANAN</b>	AL
<b>BS</b> SALES	
<b>Cash &amp; Carry Parts, Inc.</b>	PA
<b>CENTRAL HARDWARE</b>	IL, IN, MO, TN
<b>CHAMPION AUTO STORES</b>	IA, MN, MT, ND, SD, NE
<b>CONSUMER AUTO PARTS</b> NEW HAMPSHIRE CHAMP AUTO PARTS	ME

<b>cap</b> CONSUMER AUTO PARTS	MA
<b>CORVAIRS</b> AUTO PARTS	IN, OH
<b>Crown/Auto</b>	MIN
<b>DART DRUG</b>	MD, DC, VA
<b>DART HOME</b>	MD, VA
<b>ESCO AUTO SUPPLY</b>	IA
<b>FAGEN</b> Auto Parts	IL
<b>FINLEYVILLE AUTO PARTS INC.</b>	PA
<b>Heener auto store</b>	IN, OH, KY
<b>FOREST CITY AUTO</b>	IL, NY, OH, PA
<b>Frank's</b> AUTO SUPPLY	PA
<b>Fred Meyer</b> Tire and Auto Centers	AK, WA
<b>GATLINGS</b>	PA, WV
<b>Gem</b>	HI
<b>GRAND/AUTO</b>	CA, NV
<b>Guarantee Auto</b>	IN
<b>HERBIES AUTO PARTS, INC.</b>	DE
<b>Hi-Gear</b> DISCOUNT AUTO CENTERS	MO, VA

<b>HILL</b> PISTON SERVICE	IN, MI, OH
<b>Holiday</b> TIRE & AUTO CENTERS	MN
<b>Honey's AUTO PARTS</b>	AL, AR, KY, TN
<b>INTER-STATE</b> Automotive Products	CA
<b>JACKS</b> AUTO SUPPLY	TX
<b>Kmart</b>	ALL STATES EXCEPT AK
<b>KRAGEN</b> Auto Supply	TX
<b>KANG'S</b> AUTO PARTS	IL
<b>MAJOR MOTOR SUPPLY CO.</b>	IL
<b>MAPLE</b> AUTO PARTS	MA
<b>MG</b> AUTO	IL
<b>MARINO'S HOME &amp; AUTO INC.</b>	PA
<b>Mars</b>	MA, NH
<b>MID-WEST</b> AUTO PARTS COMPLUT, INC.	IA, NE
<b>Mike's Auto</b>	VA
<b>SWAN</b>	GA

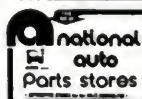




AL, AK, AZ,  
AR, CA, CO,  
FL, GA, HI, ID,  
IL, IN, IA, KS,  
KY, LA, MD,  
ME, MN, MO,  
MT, NB, NV,  
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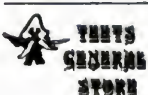
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IA, IL



TX



WV



CA



VA



CA

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IN, IA, ME, MD,  
MA, MI, MN,  
MS, NH, NY,  
ND, NC, OH,  
PA, RI, TX, UT,  
VT, WI



VA



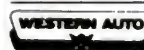
IL



NJ



MN



ALL STATES  
EXCEPT SD



KS, OK, WI



AL, AZ, AR,  
CA, CO, CT,  
DE, FL, GA, IN,  
IL, IA, KS, KY,  
LA, MA, MD,  
ME, MI, MN,  
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NV, NH, NJ,  
NM, NY, NC,  
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TX, WY



NV



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AL, CT, FL, GA,  
IL, IN, IA, KY,  
ME, MD, MA,  
MI, MN, MS,  
MO, NH, NJ,  
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VA, WI

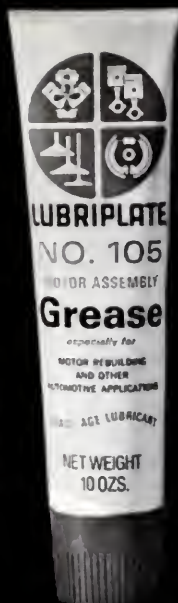


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**USE ZIP CODES  
WHEN ANSWERING  
ADS**



# FALL SECTION 2 CAR CARE GUIDE

## SERVICING THE ENGINE

(Continued from page 159)

and adjust curb-idle (slow idle) and fast-idle speeds to the specifications given in the vehicle's emission-control label.

Correct fast-idling-speed adjustment is particularly important in cold weather to prevent stalling and permit rapid engine warm-up.

### Starting in cold weather

Many drivers believe that in cold weather, a lot of gas is needed to get an engine going. They pump away on the accelerator pedal and wonder why they have problems day after day, although their engines are tuned up.

An engine won't start if cylinders are choked by raw gasoline. So, starting an engine on a cold day takes a little finesse. Follow this procedure:

**1. Turn off equipment that draws electricity.** This includes lights, heater blower motor and radio.

**2. Press the accelerator pedal slowly to the floor** once only, if the outside air temperature is 10° F. or higher. Then release it completely. If the outside temperature is lower than 10° F., press the accelerator pedal slowly to the floor twice. Then release it completely.

**3. Turn the ignition key to START,** keeping your foot off the accelerator. If the engine fails to start within 15 seconds, turn the ignition key off. Wait 30 seconds and repeat the procedure (step 2 and this step). Don't pump the accelerator pedal at any time. Doing so will flood the engine and may result in a run-down battery.

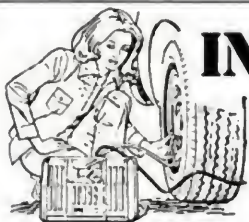
**4. Allow the engine to idle** for 30 seconds after it starts. Then reduce idling speed by giving the accelerator pedal a rapid, firm pat. If the fuel system is working, this releases the idling speed mechanism and opens the choke, slowing down the engine. **PM**



Inspect sparkplugs for carbon deposits and oil fouling. If plugs are still good, file electrodes, gap and use them again.

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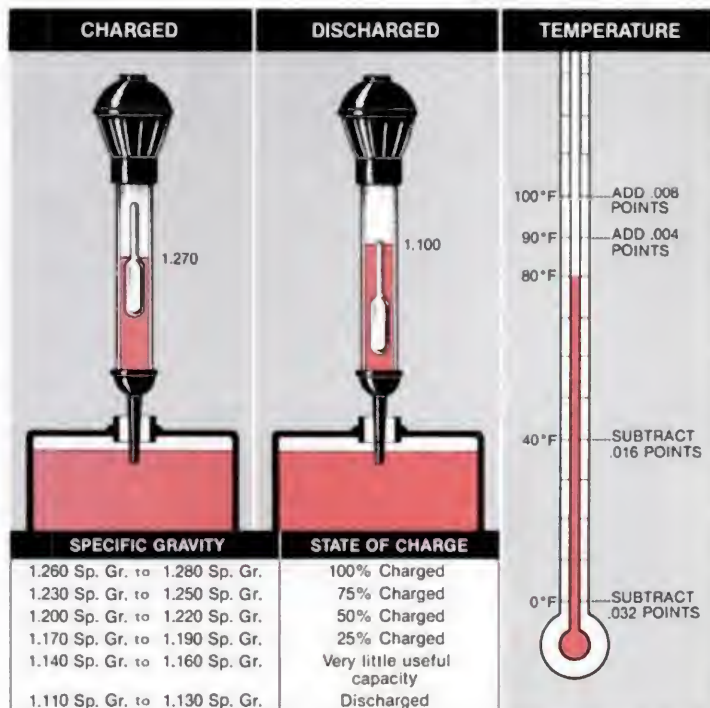
## USE ZIP CODES WHEN ANSWERING ADS



# FALL

## SECTION 3 CAR CARE GUIDE

Specific-gravity measurements have to be adjusted to temperature of the electrolyte. When temperature is established, add or subtract points according to figures on thermometer below.



## Servicing the battery

Even in warm weather, an automobile starter places a heavy load on a car battery—anywhere from a 100- to 300-ampere drain. In cold weather, if you park your car outside or in an unheated garage, the drain on the battery is normally 225 to 400 amperes.

If your battery isn't in top shape, it may not be able to supply enough current to crank the engine. You can keep this from happening by making sure the battery is at maximum efficiency and that cables are able to deliver battery power to the starter.

### Determining battery efficiency

One way to determine battery efficiency is to make a hydrometer test. A hydrometer measures the specific gravity of battery electrolyte. Test battery efficiency as follows:

**1. Clean the hydrometer inside and out.**

**2. Add water to the battery, if it's needed.** If you do add water, run the engine for at least a half hour before making the test.

**3. Hold the hydrometer vertically** and draw electrolyte into the hydrometer tube from one cell of the battery. Don't fill the tube to the point where the float jams against the top of the tube.

**4. Hold the hydrometer at eye level.** Record the reading.

**5. Return the electrolyte to the cell** from which it was drawn. Then take hydrometer readings from the other cells.

If the hydrometer you're using has a built-in temperature compensator, markings on the float will give the exact specific gravity reading of each cell. However, to attain the most accurate reading, draw electrolyte into the hydrometer from the cell. Then, discharge back into the same cell. Do this several times to stabilize the temperature in a temperature-compensating hydrometer before taking the hydrometer readings.

If the hydrometer you're using does not have a built-in temperature compensator, insert a

(Please turn to page 166)

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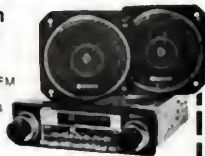
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## FALL SECTION 3 CAR CARE GUIDE

thermometer into the middle cell of the battery, let temperature stabilize and note the temperature before taking readings. You have to adjust readings in relation to temperature. True specific gravity of battery electrolyte is based on 80°F. Thus, the specific gravity readings you get must be adjusted to 80°, as illustrated in the chart.

Average the specific gravity readings from all the cells and compare what you get with the chart on this page. If the battery is in the 1.200-1.230 specific-gravity range before charging and doesn't exceed this range after charging (retest specific gravity), it's an odds-on favorite to fail this winter.

### Maintenance-free batteries

Some maintenance-free batteries, notably the Delco-Remy Freedom battery, have an "eye," which is a visual indicator for the level and specific gravity of the electrolyte in one cell. This indicator doesn't tell whether the battery is good or bad. What it does do is tell you if the battery can be tested. The indicator works like this:

If the eye has a green dot, load-test the battery with a volt-amp. meter. The way load-testing is done depends on the model of the battery. Data is available in GM service manuals and Delco-Remy service bulletin 1B-116, which you probably can't purchase. So you will have to consult a GM dealership. If minimum voltage is not attained during the load-test, replace the battery even though the green eye battery indicator is showing. The battery is defective.

If the eye is dark (no green dot), charge the battery before making the load-test. Stop charging the battery as soon as the green dot appears.

If the eye is yellow, or pale, do not charge, test or jump-start the battery. Electrolyte has been depleted, and doing any of these things causes excessive buildup of internal pressure which may cause a battery explosion. Replace the battery.



To ensure a good contact between the post and cable, clean both with sandpaper or a post-and-terminal cleaning tool.

GREEN DOT VISIBLE



SATISFACTORY STATE OF CHARGE FOR TESTING

DARK GREEN DOT NOT VISIBLE



CHARGE BATTERY BEFORE TESTING

LIGHT YELLOW



REPLACE BATTERY



Maintenance-free batteries have an eye to indicate battery condition. You test the battery with a voltmeter.

Since you can't get to the cells of most maintenance-free batteries, you need a voltmeter to determine battery state-of-charge. Follow these steps:

**1. Test voltage across the terminals** with the engine turned off and headlights turned on.

**2. Leave lights on for one minute.**

**3. Test no-load battery voltage,** that is, the voltage without any electrical equipment (lights, radio, heater, for example) turned on. A reading of 12.4 volts or more means the battery is in good shape. If no-load voltage is less than 12.4 volts, charge the battery to get it ready for winter.

### Servicing battery cables

Battery cables are often the weak link in the chain. They cause more problems than any other part of the starting system. To test your battery cables properly, you should proceed as follows:

**1. Disconnect the negative cable,** which is the ground cable, at the battery. With a battery-cleaning tool, wire brush or sandpaper, clean corrosion and dirt from the battery post and cable terminal.

**2. Disconnect the positive cable** and clean it. Then, reconnect and properly secure the positive cable, followed by the negative cable.

**3. Spread a thin coating of lubricant** over the cable terminal after the cable is reconnected to the battery. Do this after the terminal has been tightened. Lubricant between the terminal and battery post restricts the flow of current.

**4. Trace each cable back to the other end.** Look for breaks in insulation. Replace a damaged cable. Clean and tighten a good one.

Cleaning the battery need not be done unless the battery looks dirty or corrosion is present. Remove the battery, cover the vents and wash the battery with a solution of baking soda and water. Also wash down the battery holder in the car.

PM



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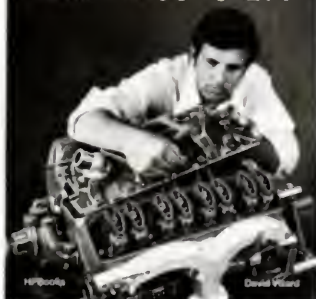
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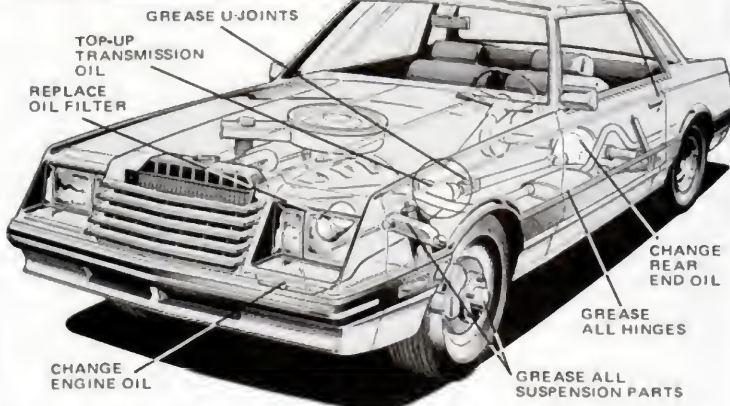
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## FALL SECTION 4 CAR CARE GUIDE



As metal contracts in low temperatures, friction surfaces are subjected to greater stress. You should lubricate the critical areas to keep moving parts from jamming.

If you recently changed oil, you should only drain it again if the viscosity of the oil can't meet the anticipated cold-weather temperature for your region. Cold causes oil to thicken. A high-viscosity oil in extremely low temperatures will thicken enough to prevent engine starting.

Viscosity numbers on the oil can are your guide. Viscosity numbers are preceded by the letters SAE, standing for Society of Automotive Engineers, which began the grading system.

Examples of viscosity numbers are SAE 10W, SAE 30, SAE 40—also SAE 10W-20W-30, SAE 10W-30, SAE 20W-50. "W" means the oil is of a viscosity thin enough to meet engine starting and operating requirements in temperatures below zero.

Some oil cans have one viscosity number, while others have two or more. Oils with one viscosity number (called single-grade oils) are less expensive than oils with more than one viscosity number (called multigrade oils).

The advantage of multigrade oils is that they allow engine starting in cold weather, while providing the protection of a high-viscosity oil when the engine is hot. Furthermore, in hot weather, the oil remains thick enough to protect engine parts. So, you have a choice to

make. But be sure the oil you choose is one that meets the anticipated winter temperature in your area. Use the data in your car owner manual as a guide.

### How to lubricate your car

Prewinter chassis lubrication is wise to protect steering and suspension ball joints from cold and road splash. Refer to the service manual for a lubrication chart that indicates grease-fitting locations. If you don't have a manual, check each pivot point of the suspension and steering network for fittings.

**1. Wipe grease fitting clean and attach a hand grease gun filled with chassis grease.** You may wish to use a gun that accepts cartridges of grease. This tool is similar to a caulking gun and has the advantage of being less messy to use than a grease gun you fill from a bulk container.

**2. Pump in grease until grease oozes from the bleed hole in the base of the ball joint seal or until the seal begins to swell.**

**3. After lubing, wipe the fittings clean again and replace rubber plugs over the fitting.** If your fittings didn't come equipped with rubber plugs, you can purchase a set easily.

To complete the lubrication phase of winterization check and replenish these fluids:

- Brake fluid
- Automatic transmission fluid
- Rear-end oil

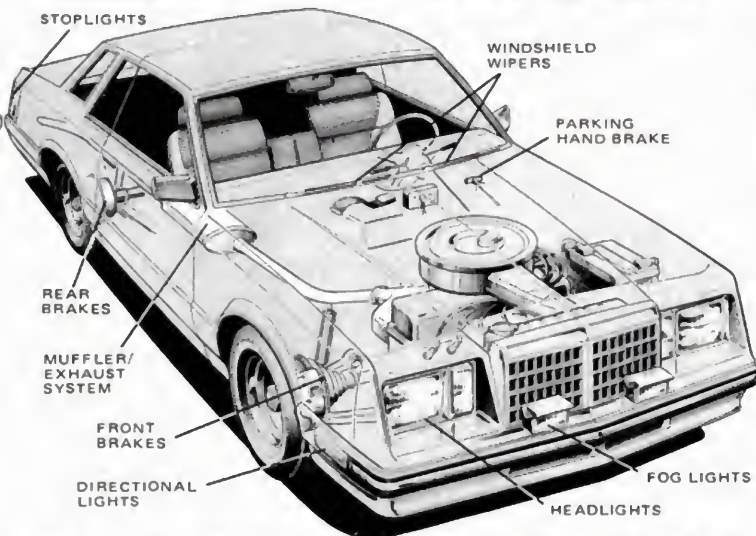
To keep the doors, trunk lid and hood from getting creaky in the cold, spread grease on the hinges. You should also lubricate the door handles lightly. However, don't use grease in the locks. The best thing to use there is graphite powder to keep the lock mechanism functional. If locks do freeze, squirt just enough deicer on them to free them. Don't allow too much to get into the mechanism.



Suspension components must be greased with a pressurized grease gun. Lubricate until grease oozes from the bleed holes.



## Safety checkup



**M**aking sure safety-related components are in good condition should be a year-round job. But some things a driver may overlook during warm weather will constitute a serious hazard in the winter.

A hole in a muffler, for instance, is always dangerous, but driving with windows open when the weather is warm reduces the possibility of carbon monoxide (CO) poisoning. In cold weather, with the car buttoned up tightly and the heater blower running, driving with a bad exhaust system is tantamount to a death sentence. CO kills silently.

Lights help you to see during the reduced daylight hours of winter and also help other drivers see you—if they're working. Make sure they are.

Turn on your parking lights and determine that they and these other lights shine: side-markers, taillights, brake lights (have someone step on the brake pedal), high beams, backup lights, license-plate lights and, if you have them, fog lights. Replace burned-out bulbs and lenses that are broken or cracked. A bad lens allows moisture to enter the fixture, possibly causing the light to short out. Wash headlights often in winter. Road splatter covering lights can reduce their output by as much as 50 percent. Clean the lenses of other lights, too.

Have someone start the engine and shift the car into reverse gear as you check backup lights. Test the turn signals and hazard warning flashers. If any signal doesn't work, check the bulb for a burned-out filament. If the signals fail to work and the bulbs are okay, chances are that the flasher is defective; replace it.

The average life of windshield-wiper blades is 18 months. Shortly before or after this, the rubber gets hard and brittle and begins sepa-

**Safety-related components must be inspected periodically. A borderline component in summer will fail in the winter.**

rating. Chattering is a sign that wipers are beginning to wear and should be replaced. Chattering refers to the noise and jerking motion wipers make as they sweep the windshield. Wipers should glide smoothly.

Sometimes, even new windshield-wiper blades chatter. This signifies that the blades haven't been installed properly or that wiper-arm tension has to be adjusted. Chatter may also be caused by a worn windshield-wiper linkage, in which case the entire assembly should be replaced. You can usually prevent excessive assembly wear by applying a smear of lubricant to the pivot shafts where wiper arms attach to the motor.

After checking windshield wipers, test windshield-washer nozzles. If the jets are clogged, insert a fine wire in each hole to clean out dirt. Be careful not to enlarge the openings.

### Under-car components

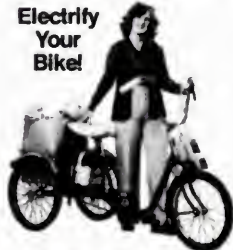
**1. Examine the exhaust system for imminent failure by checking parts for holes** and probing with a screwdriver to reveal almost-rusted-through sections. Replace any part that is rusted out.

**2. Grab each section of the steering linkage and attempt to shake it.** If there is any looseness, the part is probably worn and should be replaced.

**3. Examine shock absorbers,** which should be in good condition to assure driving stability. If fluid is leaking, replace both shock absorbers on the same axle of the car—that is, either up front or in the rear.

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## DRIVING THE GM MODELS

(Continued from page 95)

the Oldsmobile Cutlass Supreme; the latter displaced Chevy's Impala some time back as America's most popular car model. While they share a common basic body-on-frame structure, each has its own distinct divisional look and identity and many unique features. They compete intensely among themselves, as well as with Ford's Thunderbird and Mercury Cougar and Chrysler's Cordoba and Dodge Mirada.

For 1981, all have spent many hours in the wind tunnel having their handsome shapes massaged for aerodynamic improvements ranging from 10 percent for the Monte Carlo to 20 percent for the Grand Prix and Cutlass Supreme. Lower noses, higher rear decks and smoother flanks give their profiles a subtle wedge shape to punch a cleaner hole in the air.

### Electronics galore

Most important among the engineering improvements is the new, highly sophisticated electronic engine-control system, which has been added to all 1981 GM cars. Called Computer Command Control, it monitors all critical engine and environmental conditions and precisely regulates air/fuel mixture, ignition spark advance, idle speed and emissions controls to meet the much tougher 1981 pollution standards. It even controls a clutch in the automatic transmission torque converter, which locks up in high gear to eliminate fuel-wasting hydraulic slippage at cruising speed. It also warns of system malfunctions (with a CHECK ENGINE light on the instrument panel) and helps service technicians diagnose and correct any troubles.

Like other '81 models, the new A-specials get high-pressure (35 p.s.i.), low-rolling-resistance metric radial tires to further improve fuel efficiency, plus computer-tuned structural, suspension and body isolation changes. Self-sealing tires (Uniroyal Royal Seals) are a new option on these and most other '81 GM cars, as is a redesigned cruise control system with a "resume" feature added to regain desired speed after braking.

Convenient side-lift jacking improves roadside serviceability.

Already some of the industry's nicest-driving cars, the new A-specials are even better for 1981. Interiors are quiet, roomy and comfortable, and come with a huge variety of convenience options and plush appointments. The ride/handling compromise is outstanding across the board, with each division offering slight differences in suspension tuning and road feel, in keeping with their individual images.

One really significant engineering achievement, however, is Cadillac's exclusive "V-8-6-4" modulated displacement system on its '81 6.0-liter gas engine. An Eaton Corp. invention under development since the early 1970s, it cuts out two or four of the engine's eight cylinders whenever full power isn't needed.

Chevrolet Div. also deserves recognition for coming up with a terrific high-performance "X-11" version of its hot-selling Citation coupe. Much more than just spoilers and cosmetics, it combines special suspension and tires with a high-output (about 135 hp) 2.8-liter V6 into a domestic product that's the most fun in years.

Chevrolet Malibu and Pontiac Le Mans mid-size four-door "A-cars" inherit the squared-off "formal" roofline from their Olds and Buick cousins, while Camaro/Firebird and most full-size models get the low-drag front disc brakes introduced on last year's X-cars.

These and other improvements should keep GM rolling along until its mighty new-model machine gets cranking again come spring.

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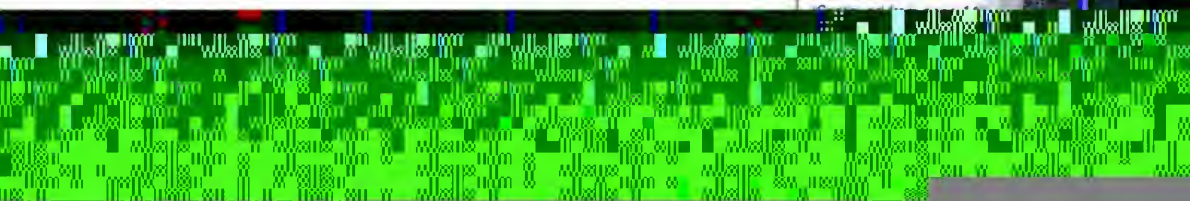
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